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ADVERTISEMENT.

One notable feature of modern civilisation is the development of the advertisement. It is no longer sufficient simply to post the name of an article on the hoardings. Advertising has become an art, and the advertising agent one of the most important persons in business. Apart from pictorial aids, the advertiser frequently endeavours to make his advertisement as much unlike an advertisement as possible, and hence appear articles on general topics, in which the thing advertised is mentioned merely incidentally.

Many of these interesting articles stray into the news columns of the daily press, though some unsympathetic editors insist on placing the abbreviation "advt." at the end, which rather detracts from their efficacy. Hence there has arisen a more subtle form of advertisement,—the issue of a journal which provides general information without any disfigurement by advertising matter. Such a journal will be purely educational, and written in a bright and lively style so as to interest its readers. This is a favourite device in regard to anything scientific, and the excuse for its existence is that it translates the abstruse and technical language of the scientist into something which can be comprehended by the consumer with the minimum of mental effort.

But it is scarcely to be expected that the philanthropist who bears the expense of such a journal is out to boom other people's goods. Consequently the good points of other products are liable to be slurred over, and any defects emphasised. Moreover, scientific facts sometimes get entangled in a context which gives them quite a different meaning from that which the scientist allows them. On the other hand, the facts in favour of the article for sale are naturally presented in the most favourable light. The propagandist is apt to impart a polish to his facts, and to paint the fair face of truth.

Ceylon has always been the happy hunting ground of the advertiser and the stunt merchant. We are informed that, relatively to the number of the educated population, the consumption of patent medicines in this country is enormous. But, being an agricultural country agriculture has had to suffer most in this respect, from the days of Capability Bennett onwards.

Numerous examples, sometimes honest but mistaken, will readily occur to our readers, though the law of libel prevents their enumeration here. All find a ready welcome in Ceylon. There does not appear to be in this country a sufficiently large body of informed opinion to influence the public mind, while the only people who are considered by universal consent to know nothing whatever about such matters, are those who have been engaged by Government ostensibly for their knowledge of them.

The question arises, what is the duty of a Department of Agriculture in such cases? Is it to point out elementary fallacies, or obvious distortions of fact, and to track down misrepresentations, or is it to ignore them, knowing that time will bring the remedy? The medical profession does not bother about the consumers of patent medicines; perhaps it knows that it will get them in the end.

It is urged that we should adopt the principle of "live and let live." That, however, argues that we are playing the same game. One would rather call it the principle of least resistance. The only argument in its favour is that time spent in meeting fallacies and misrepresentations is time wasted.

One thing at least the agriculturist can be certain of, namely, that the advice given by officers of a Department of Agriculture is not influenced by commercial considerations. Moreover, as regards both general scientific principles and their practical applications, it is as up-to-date as a continuous study of the latest scientific and technical journals can make it. In these circumstances the planter must not be surprised if we refuse to be taught elementary science from propagandist leaflets, or to spend time in demonstrating misrepresentations.

TEA.

THE CHEMICAL ANALYSIS OF TEA WITH REGARD TO QUALITY.

J. J. B. DEUSS,

Chemist at the Experiment Station for Tea, Buitenzorg (Java).

The quality of tea is determined by its appearance, its aroma, the infusion obtained by placing 3 grammes of tea in 150 cubic centimetres of boiling water for five minutes, and the colour of the leaf after infusion.

Chemical analysis has not yet given valid data. It is important to know the moisture-content of tea before packing it, and especially for retail, this moisture-content should not exceed 6 per cent. The percentages of caffeine, tannin and other substances are only of slight value as regards quality and do not permit of the classification of teas, as has often been tried.

In an article which appeared in *l'Agronomie Coloniale*,* the author seems to be convinced that a good tea contains little tannin and caffeine. If this were true, most of the teas of the first quality would be placed in an inferior group.

Experiments have shown that the caffeine-content of the fresh tea-leaf does not change during the manufacture of black teas according to the European process, *i.e.* by machinery.† The tannin-content may diminish by oxidation and by being rendered insoluble as a result of too high temperatures during the withering and drying.

An excessive prolongation of fermentation diminishes the tannin-content and causes weak teas (China and Indo-China teas).

The portion soluble in hot water likewise diminishes by desiccation during withering, by a too prolonged fermentation, and by too severe drying.

It follows from all this that teas cannot be judged for quality by chemical analyses.

On the other hand, analytical methods ought to be clearly described, because they are not always comparable.

I give below a summary of the analytical methods followed by me in my researches on the quality of tea. For a more detailed description I must refer my readers to the original article.‡

For determining the caffeine-content, I have treated 10 grammes of tea containing 20-25 per cent.§ of water with chloroform in a Soxhlet apparatus.

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* (March-April, 1919). The Future of Indo-China Tea, C. Chalot.

† P. A. Keiller, Chemist of the Commercial Company, Colombo, has published in the *Tropical Agriculturist* for June, 1923, a study of the loss of caffeine which tea leaves undergo during drying.

‡ Mededeelingen van het Proefstation voor Thee, Buitenzorg, Jan. No. 42. Chemical Wechblad, 1915, p. 938; 1916, p. 66 and 692.

§ Caffeine cannot be extracted quantitatively from dry tea.

This extraction takes about two hours. The chloroform is distilled off, and the residue is taken up with boiling water ; a few drops of a solution of lead acetate are added, and the solution is made up to 125 cubic centimetres in a measuring flask. It is filtered through a dry filter; 100 cubic centimetres of the almost colourless solution are taken and treated in a separating funnel with 60-70 cubic centimetres of chloroform three times. All the caffeine is dissolved in the chloroform; the latter is distilled from a small light flask, in which the caffeine is weighed after drying at 100-102°C.

The caffeine-content thus obtained for different teas is as follows :—

Java teas from different estates and of different grades	2·7 to 4 %
Japan Green teas of different grades ...	2 to 3·3 ,,
China tea from Amoy (black tea)	2 ,,
Tea of Tai Pin (black tea)	3 to 3·7 ,,
Tonkin Green tea pressed in cubes	1·5 ,,
Flower tea from Indo-China	1·5 ,,
Man-Hao tea	3 ,,
Tonkin tea intended for export	3·1 ,,
Several Indo-Chinese teas without other specification	3·2 to 4·1 ,,
Formosa-Oolong tea	3·1 to 3·7 ,,
Burma tea, buried and prepared in Burma fashion	traces
Guatamala tea	3·5 ,,

These figures show that there is no relation between the caffeine-content and the quality of tea. The Green teas of Japan, the Oolongs of Formosa and the Indo-Chinese teas, still prepared by primitive methods, cannot be compared with Java teas. Burma tea contains only traces of caffeine; it is prepared by boiling the fresh leaves, which are then rolled up in cylindrical form in old newspapers, and these bundles are buried in the ground, to be eaten, as a vegetable, after some months. The boiling water has evidently extracted almost the whole of the caffeine.

For determining the ash-content, a small quantity of tea is incinerated in a porcelain crucible. The ash is highly hygroscopic.

The ash-content is almost constant for all the teas examined, and varies from 4 to 6·5 per cent. There are some exceptions, especially the green teas of Japan which have a higher ash-content, rising to 9 per cent. Burma tea, too, gives an ash-content of 9 per cent. These high figures may be due to the presence of impurities, as will certainly be the case in a tea which has been buried.

Flower teas have given a figure of 4 per cent. This too is a tea that cannot be compared with others, for it is prepared from the flower buds, while the other teas are manufactured from the leaves of the tea-plant.

The determination of the ash-content does not indicate anything as regards quality. The ash-content and the alkalinity of the ash can only be of use in investigating adulterations of teas.

A more important factor is the quantity of matter soluble in hot water and giving an infusion, as I described at the beginning of this article. Three grammes of tea are taken and this is placed in 150 cubic centimetres of boiling water for five minutes; then it is filtered into a measuring flask

of 250 cubic centimetres through cotton-wool, because paper retains too much tannin and soon gets clogged. It is washed with very little water (50 cc.), and the flask is filled up to the mark. 100 cubic centimetres of this extract are evaporated, dried at 105°C. and weighed.

The figures obtained in this way are often very different for teas from the same country.

Java teas from different estates and of different grades	16 to 26 %
Japan Green teas of different grades ...	16 to 26 ,,
Black China teas	16 to 22 ,,
Flower tea	2·7 ,,
Tonkin Green tea, pressed in cubes	14·2 ,,
Man-Hao tea	13·2 ,,
Tonkin tea intended for export	14·7 ,,
Black teas of Indo-China (without other specification)	16 to 23 ,,
Formosa Oolong teas	23 to 25 ,,
Black Guatamala tea	17·4 ,,
Burma tea	19·2 ,,

Again, there is no relation between these figures and the quality of the different teas. The Black teas of China give nearly the same figures as those of Java and the Green teas of Japan. The black teas of Indo-China, bearing no indication of origin, resemble China teas. These two classes rarely present high figures, probably because of too prolonged fermentation.

The 'Oolongs' yield a large amount of soluble substances because their fermentation is incomplete.

The low figure for flower tea is accounted for by the fact that drying has destroyed, to a great extent, the solubility of the small quantity of soluble matter.

I am unable to account for the low figures of Man-Hao tea and of Green tea pressed into cubes. It may be that the process of manufacture is solely the cause. The Black tea of Tonkin, intended for export, presents a low figure as a result of too prolonged fermentation or too severe drying.

The ash-content of the infusion has been determined and varies (calculated on dry tea) from 12·8% to 13·9%; this figure is not of any interest.

For determining the tannin-content I have treated the tea with boiling water in a Soxhlet apparatus. This extract was treated with 25 cc. of formalin (40 per cent.) then with 25 cc. of concentrated hydrochloric acid. It is again moderately heated for a quarter of an hour. The rose-brown precipitate is filtered, washed, and weighed. The product obtained is a tannin compound of the tea tannin. A gramme of tannin from pure tea gives 1·24 grammes of the tannin compound.

It is necessary to avoid using paper in extraction apparatus, but to use apparatus having an internal extraction tube of glass, separate from the rest of the apparatus. It is stuffed with cotton-wool.

Filtering is best done with porous crucibles which do not require paper.

The figures obtained again do not show any relation to the different qualities. In a series of analyses of Java teas carried out some years ago, I believed I had found a certain relation. The best teas contained more tannin than the others. This relation is not constant, and, even on the first occasion, the differences were so slight that it was not possible to base on this result a rule as regards tannin-content and quality.

I obtained the following figures :—

Java teas from different estates and of different grades	6 to 20 %
Japan Green teas of different grades ...	4 to 12 ,,
Black China teas	5 to 10 ,,
Flower tea	1·7 ,,
Different Indo-China teas	5 to 8 ,,
Formosa-Oolong teas	12 to 23 ,,
Guatamala tea	5 ,,
Burma tea	9·5 ,,

From these figures no conclusion can be drawn as regards the comparison of teas from different sources. Flower teas contain hardly any tannin. In the other teas the tannin has been rendered insoluble to a varying extent by the methods of preparation.

It is very important, for the determination of the tannin-content, to have fresh teas ; in old or mouldy tea much less tannin is found. Mouldy teas especially show a strong diminution in tannin-content. It is thus possible that certain rather low figures for teas other than those from Java are due to that cause. For certain Java teas the low tannin-content is due to defective manufacture.

The final conclusion of this survey is, in my opinion, that it is impossible to establish a connection between the percentages of the different substances shown above and the quality of the teas.

The good grades, prepared in British India, Ceylon and Java originate from rational cultivation and manufacture. In the same way as there are different vintages of wines there are different vintages of tea. In the same country, at the same elevation, one can have teas of very different qualities made by the same processes of manufacture. The volcanic regions of recent formation in Java yield a very fine and very special quality ; but this does not imply that all plantations situated on these soils yield a good tea.

No one has ever tried to diminish the caffeine and tannin-content in order to produce better teas. Caffeine is not considered in the process of manufacture, while tannin and its decomposition products form the essentials of what is drunk in a cup of tea.

The aim of this article is not to enter into more detail, which will lead us too far. I wish to conclude by recommending to the future tea-growers of Indo-China, Neuville's book, *The Technology of Tea*, a new edition of which will appear soon.—L'Agronomie Coloniale, No. 80, 1924.

COCONUTS.

ABSORPTION BY COCONUT ROOTS.

In the *Philippine Journal of Science*, Vol. XXV, pp. 51-72, Espino and Juliano have recorded the results of experiments carried out on coconut palms five years old for more than a year, to ascertain the rate of absorption of complete nutrient solutions by the roots of the coconut palm. It is considered that these experiments may be of value in indicating the amount of water and the kind of manure which the plant requires.

Copeland carried out similar experiments in the Philippines, but worked with single salts. As it is known that other plants grow better in complete and balanced culture solutions than in solutions of single salts, these experiments were performed with culture solutions containing three and four salts respectively in different proportions. The salts employed were monopotassium phosphate, calcium nitrate, and magnesium sulphate in the three-salt solutions, and the same with ammonium sulphate in the four-salt solutions.

The solution which was absorbed most rapidly was a four-salt solution containing one part of ammonium sulphate, one part of potassium phosphate, one part of calcium nitrate, and five parts of magnesium sulphate. A similar solution, but in weaker concentration, had previously been found good for young rice-plants. A similar proportion of the last three salts, however, in the three-salt series did not prove the best of that series, and consequently the result cannot be ascribed to the comparatively large amount of magnesium sulphate. The authors suggest that the greater absorption of the four-salt solution than any of the three-salt solutions was due to the addition of ammonium sulphate, and point out that it had previously been found by Bacomo that ammonium sulphate induced rapid growth in young coconut palms.

The rate of absorption of the best solution gradually increased from early morning to between one and two o'clock in the afternoon, and then gradually decreased, with slight fluctuations, until early next morning. That corresponds with Copeland's measurements of the transpiration of the leaflets of the coconut palm, and hence it is suggested that transpiration may serve as an index of absorption, or *vice versa*. The coconut palm, apparently, does not store up water.

The apparent width of the leaflet may also serve as a rough index of the rate of absorption. As is well known, the two halves of the leaflet tend to fold together downwards when the leaf is losing water too rapidly. But under normal conditions, rapid absorption takes place when the leaflet is somewhat closed, as there is then an apparent deficiency of water in the leaf.

The absorption is proportional to the evaporating power of the air. From this the authors suggest that coconuts may be cultivated successfully in a dry region where the evaporating power of the air is great, provided

that soil moisture is liberally supplied. In Ceylon, it is well known that coconuts will grow in the dry zone near a tank, where they can obtain the seepage water from the tank. But if coconuts are grown under irrigation, it is quite easy to over-irrigate them. The difference, however, probably depends on the mechanical condition of the soil in the two cases.

The rate of absorption by the roots during a period of sunny days was, on the average, about 233 per cent. more rapid than during a rainy period.

Copeland estimated that a full-grown coconut palm absorbed twenty-four litres (about 5¼ gallons) per day. The maximum observed by Espino and Juliano was sixteen litres per day.

NUTFALL OF COCONUTS.

In an article on the Manuring and Cultivation of Coconuts, in a recent number of this Journal, there occurs the following explanation of nutfall.

"The premature fall of nuts is brought about by the weakness of the slender stalk which connects the nut to the flowering spike. On neglected estates these stalks are feeble and brittle, the consequence being that many of them snap when the palm is shaken by the wind, or when the growing nut is pushed aside by a more robust neighbour. On those estates which are cultivated and manured these stalks are much more strongly developed and they are also far more supple, with the result that they merely bend instead of breaking when they are subjected to extra strain."

We apologise to our readers for the evident failure of the editorial blue pencil. The explanation might be plausible, but for the fact that there is no such stalk. As any coconut planter can readily observe, nutfall is not brought about by the breakage of a stalk or of the branch of the inflorescence to which the nut is attached. We would recommend the author of this explanation to examine a coconut inflorescence, the next time he travels "from Pedro Point to Dondra Head, from Colombo to Trincomalee." At the same time, we willingly grant that his "position to write authoritatively on the subject of coconut cultivation," as evidenced by the foregoing quotation, is certainly "unique." Most people would take the trouble to ascertain the structure of a coconut inflorescence before venturing to theorise on nutfall.

THE INFLUENCE OF MANURES ON COCONUTS.

It is a known fact in horticulture that application of too much nitrogenous manures causes the plants to vegetate at the expense of flowers and fruits, while lime and phosphates tend to divert this energy in the opposite direction, namely to the production of flowers and fruits. Does the same thing occur in coconuts? What manures exert beneficial influence on the flower production in coconuts and what others act detrimentally? Unfortunately coconuts have received very little attention in this line from the investigators and hence our knowledge is at present very limited.—C. X. Furtado, in Gardens' Bulletin, Straits Settlements, Vol. III., Nos. 7-8.

CACAO.

FERMENTATION OF CEYLON CACAO.

A. W. KNAPP.

Below I give a report on the 6 bags of Ceylon Cacao that you submitted to me. They reached me about 12th August, 1924. The gross weight of the 6 bags on arrival was 704 lb. and each cwt. was in a double bag.

The following is the description of the preparation of these samples as given by the Manager at the Experiment Station, Peradeniya :—

"All lots fermented in cement tanks lined with Skene's wax, a local preparation which gives a hard smooth surface. False floors of wood slats covered with coconut matting were inserted permitting an air space of 4 inches between the slats and the cement floor. Each lot consisted of 300 lb. of wet cacao. The cacao was taken from the ordinary mixed crop of the station. No picking over or grading was done. The weather throughout the experiments was rainless, dry and sunny, except for one cloudy day. All the cacao was sun dried on cocount matting for 4 hours daily during the drying period. When not on the drying floor the cacao was bagged in gunny bags and heaped together. All lots received one thorough washing after final removal from the fermenting tanks and before sun-curing commenced.

"*Series 1.*—All lots were put into the tanks about 4 p.m. and the cacao covered with gunny bags.

"*Lot No. 1*, was changed into the next tank at 8-30 a.m. on the following day and removed for washing and sun drying at 8-30 a.m. on the next day.

"Total fermenting period 40½ hours.

"*Lot No. 2*, was fermented for 64½ hours being changed into the next tank daily between 8-30 a.m. and 9-30 a.m. (two changes only).

"*Lot No. 3*, was fermented for 88½ hours being changed into the next tank daily as lot 2 (three changes in all).

"*Series 2.*—Same procedure as Series 1, but the cacao was left uncovered in the tanks.

"The total period of sun drying was 4 hours daily for 7 or 8 days in each case."

My first thought on reading the above was that if I had understood the matter correctly, and the total quantity in each fermenting tank was only 300 lb., it was unlikely that any Forastero cacao present would be fully fermented, as with small quantities like these the heat produced generally escapes too rapidly to allow the proper rise in temperature. It would have added to the value of the experiment if the temperatures of the cacao had been recorded at intervals of, say, 12 hours.

(1) Cacao Used in the Experiment.

In an ideal experiment one would only test one variety of cacao, but in practice a mixture has generally to be dealt with. On examining the cacao, I found that the various samples had differed in quality before fermentation

and hence it was more difficult to judge the effect of the different treatments. In experiments of this kind it would be well to give the whole of the wet cacao a thorough mix before the various portions were put on for a test. The interference which occurs in valuing, due to the different percentages of Criollo cacao present, would then disappear and the value of the different treatments be more evident. According to our cuttings of 100 beans the Criollo and Forastero present were as follows :—

Percentage of Criollo and Forastero.

	Series 1, (Covered.)			*Series 2, (Uncovered.)*		
	Lot 1.	*Lot 2.*	*Lot 3.*	*Lot 1.*	*Lot 2.*	*Lot 3.*
Criollo ...	50	44	28	35	31	31
Forastero ...	50	56	72	65	69	69

It will be noted that in these cocaos the Forastero is predominant.

(2) External Appearance of the Finished Cacao.

The beans had not been sorted or graded, but the general appearance was fairly bold.

Weight and Size of Beans.

	Series 1.			*Series 2.*		
	Lot 1.	*Lot 2.*	*Lot 3.*	*Lot 1.*	*Lot 2.*	*Lot 3.*
Weight of 100 beans in grams ...	110	110	97	109	110	104
Shrivelled beans ...	10%	8%	8%	6%	6%	6%

As far as colour was concerned there was no doubt that No. 1 (40½ hours' fermentation) in each series was the prettiest ; they were a pleasing brick-red in colour, and were very clean. Nos. 2 and 3 (64½ and 88½ hours fermentation) were not so bright a red and showed grey stains (probably due to the pulp being imperfectly washed away). Curiously enough those fermented the least time (No. 1) were the most plump. I would suggest that the beans never reached such a temperature that they became full of juice. In Nos. 2 and 3 the shells were brittle and frail, and some were broken. The various lots in the two series were very similar in appearance, but those prepared in a covered tank were slightly brighter.

(3) Internal Appearance.

It is worthy of record that not one mouldy, grubby or germinated bean was found in any of the samples.

With regard to fermentation, no sample was entirely unfermented, and no sample completely or properly fermented. The two series were very similar.

Percentage of Unfermented Beans.

	Covered Tanks.			*Uncovered Tanks.*		
	Lot 1.	*Lot 2.*	*Lot 3.*	*Lot 1.*	*Lot 2.*	*Lot 3.*
Period of fermentation in hours ...	40½	64½	88½	40½	64½	88½
Imperfectly fermented ...	50%	30%	20%	50%	30%	20%
Entirely Unfermented :—						
Criollo ...	6%	11%	4%	8	10%	8%
Forastero ...	14%	—	—	25%	—	—

The beans that had been in the tanks only 40½ hours were obviously unfermented; the shells clung tightly to the cotyledons, and in sections of the Forastero beans the pigment cells present in the fresh beans could be plainly seen. There was not much difference between the 64½ and 88½ hours' samples; they were slightly, but imperfectly fermented; and the colour of the section was darker, but duller than the 40½ hours' sample.

I was surprised to find that every sample contained incompletely fermented *Criollo* beans, as I was under the impression that these were easily fermented in short periods; only the 40½ hours' samples showed Forastero beans in the condition in which they come from the pod, that is with undistributed patches of purple pigment.

All the samples had a strong acetic acid odour. They had a brittle break and were well dried.

(4) Aroma on Roasting.

One's opinion on this was confused by the varying amount of Criollo cacao present, but, in my opinion, there was no doubt that the 40½ hours' sample had an inferior aroma characteristic of unfermented cacao. There was little to choose between the 64½ and 88½ hours' samples, but they were obviously superior to the 40½ hours' sample.

(5) Opinion on the Various Treatments.

Taking all these results together, and attempting to take into account the differences due to the varying percentage of Criollo beans, I place the 64½ and 88½ hours' treatment as equally good, and both superior to the 40½ hours' treatment.

(6) Suggestion for Experiments.

It is unsatisfactory to attempt to ferment Criollo and Forastero together, as it is not possible for one set of conditions to be ideal for both; they should, where possible, be separated. However, on many plantations this will not be a practical proposition. As the Forastero strain in Ceylon cacao has been getting stronger for some years (a change which I think is much to be regretted), it might be well for some plantation where Forastero predominates to attempt to produce a typical Forastero fermentation. Fermentation would be continued for at least five days, and an attempt made to get the temperature to rise somewhat as follows :—

After	24 hours	...	89°F.
,,	48 ,,	...	98°F.
,,	72 ,,	...	115°F.
,,	96 ,,	...	117°F.
,,	120 ,,	...	117°F.

It would probably be unwise to wash this cacao as it might make the shells too thin to stand ordinary rough handling. In this case one is up against the practical difficulty that this cacao would not be recognised as Ceylon, and hence until its properties became well known, would suffer in price.

(7) Valuation.

It is evident from the above that if I attempt to ignore all difference not due to treatment I should value the cacao which was only fermented 40½ hours as worth less than the others. Our own buyer, taking the samples

as they stood, valued them on the 18th August, 1924, as follows :—

Series 1.	(Covered)	Lot 1	(40½ hours)	82/- per cwt.
		,, 2	(64½ hours)	85/- per cwt.
		,, 3	(88½ hours)	80/- per cwt.
Series 2.	(Uncovered)	Lot 1	(40½ hours)	85/- per cwt.
		,, 2	(64½ hours)	85/- per cwt.
		,, 3	(88½ hours)	80/- per cwt.

It may be mentioned that when purchasing Ceylon Cacao we would always prefer to buy a pure Criollo rather than a mixed breed.

About the same date the above cacaos were described and valued by our Brokers in London as follows:—

Series 1.	Lot 1.	Fine bright red, rather smaller, fine brown break ...	95/-	96/-
,, 1.	,, 2.	Fine dull red, ungarbled, bolder, mixed break	86/-	87/-
,, 1.	,, 3.	Fine dull red, ungarbled, mixed break	85/-	86/-
Series 2.	Lot 1.	Fine bright red, good pale break, a few purple	97/-	98/-
,, 2.	,, 2.	Fine bright red, ungarbled, mixed break	87/-	88/-
,, 2.	,, 3.	Fine dull red, ungarbled, dull break, slightly defective ...	85/	86/-

The average price of Ceylon Cacao at that time may be taken as about 90/- per cwt.

It will be noted that these valuations were somewhat higher than those of our Buyer, but the most striking disagreement is with regard to the pretty unfermented cacao, for which evidently there is a particular market, where presumably external appearance is highly valued. In arriving at the valuations our Buyer ignored the outside appearance and considered only the fermentation and the break of the cacao with regard to the suitability for our particular purpose. The Brokers, however, would consider the outside appearance of the cacao, knowing that there is a demand for this in certain markets.

We then asked the Brokers to dispose of the cacao on "duty paid" terms; they replied that they thought they would be able to get about the prices they had given, but when selling on "duty paid" terms it was not always possible to get the full value. We requested them to sell about 1st September, and obtained 85/- per cwt. Cheque for £26 1*s.* 3*d.* was sent as requested, to the Crown Agents for the Colonies.

[Note.—The cacao on the Experiment Station, Gangaruwa, where these experiments were conducted, is almost entirely Forastero. Lock in 1904, found that in this Forastero 63 per cent. of the seeds were purple, and 37 per cent. white. The figures given above as the percentages of "Forastero" and "Criollo" in these samples total to 381 of the former and 219 of the latter, or a percentage of 63·5 of "Forastero" and 36·5 of "Criollo." There is consequently little doubt that the samples were not mixed, but were ordinary Ceylon estate Forastero, which contains purple beans and white beans in the same pods.—Ed.]

FRUITS.

PINE-APPLES IN THE STRAITS SETTLEMENTS.

The following extract is taken from the *Malayan Agriculture Handbook* 1924:—

In the Malay Peninsula the pine-apple is grown both for dessert and canning purposes; the largest planted areas are to be found in the Island of Singapore, where there are several large canneries engaged in the preserving of the fruit. The local industry is very large, as will be seen from the following figures, which show the exports from Singapore during the past three years.

	Quantities. Cases.	Value. $
Exports, 1919	255,873	3,286,001
,, 1920	446,890	7,177,976
,, 1921	662,360	6,210,383

The rise in the value of exports in 1920 was due partly to the revival of trade, immediately after the war, and partly to the fact that supplies of tin plate, practically unobtainable during the war, were more available. The principal country for exports is the United Kingdom, but Canada. British India and the United States of America absorb fairly large stocks.

Cultivation for Canning.—The variety most commonly grown for canning is a "Queen" type of pine, which is very similar to the "Red Jamaican Pine" of the West Indies. The fruit is very small, weighing from 3 to 5 lb. and has an excellent flavour when tinned. The "Mauritius" and the "Smooth Cayenne" or "Kew Pine" are chiefly grown for dessert purposes.

Although the pine-apple will grow on most soils, provided they are well-drained, it usually thrives best on the stiff clay types of soil. A rich soil appears to be unsuitable as it tends to develop the size of the fruit at the expense of the flavour. Pines grown on some of the poorest Singapore soils have the best flavour when canned.

Planting.—The pines are propagated usually from the suckers which are obtained from the base of the fruit, the suckers being allowed to dry slightly in the sun before planting. They can be propagated also by means of the off-shoots or suckers from among the lower leaves of the plants. A common method of planting is in rows 5 feet apart, the plants being spaced 2½ feet apart in the rows, with a 6 foot path at every 100 feet. About 3,000 suckers are required to plant up an acre.

After planting, the fields require careful weeding, but are not generally manured. Fortunately the pine-apple has few insect enemies and is not subject to many diseases.

Yield of Fruit.—The pines begin to fruit at from 12 to 18 months, and during the first year of fruiting will produce one fruit per plant ; but, with good cultivation, they should produce an average of about two fruits to each plant every year after the first year of fruiting. Under ordinary conditions the average yield of pines is about 4,000 to 5,000 per acre per annum.

There are usually two main crops during the year, the first in May and June and the second in November and December, but the crops depend very much on rainfall. When there is a spell of dry weather of long duration the pines do not fruit.

A properly cared-for estate, as cultivated in the Straits Settlements, will produce good fruits for 5 to 6 years, after which the pines gradually become smaller, and it is usually found necessary to remove the old plants and replant strong fresh suckers.

Canning.—The pine-apple canning or tinning industry is in the hands of Chinese merchants. In the Straits Settlements, the pines are always peeled and cut by hand, as hand labour is found to be more economical. The peeler wears a rubber glove on the left hand as a protection from the juice of the fruit. After peeling, the pines either whole, in slices or in cubes are placed in tins, which are filled either with water or syrup. In the case of whole pines, the cores are removed previously, if required, by a tin tube which is pressed through the centre, but most pines are tinned without coring. The syrup consists of about 3 parts of sugar to 100 parts of water, but is varied with the ripeness of the fruit. After the pine is put into the tin, the tin is soldered up and a number of tins are placed on a wooden rack slung on wires and plunged into a rectangular tank of water heated by means of steam-coils. The tins are boiled in this tank for ten to fifteen minutes in the case of the smallest tins, and up to an hour for large tins, the biggest tins weighing 5 pounds when full. After removal from the boiling water a puncture is made in the top of the tin with a hammer and punch ; in large tins two punctures are made. This is done to allow the steam to escape ; the holes are resoldered and the tins plunged again into boiling water for about nine minutes. They are then labelled and packed in boxes for export.

The forms manufactured for export are (1) whole pines, (2) sliced pines, and (3) chunks or cubes. The most popular size is the 1½ lb. tin, which is shipped in wooden cases containing 4 dozen tins.

Machinery.—The greater part of the machinery employed in the canning factories is necessary for the manufacture of tins, and consists of tin plate cutting machines, cover and bottom presses, and rolling machines for making the tins. The tin plate is imported from the United Kingdom and the tins made completely in the canning factories in Singapore.

General.—Owing to the main crop maturing in two comparatively short seasons during the year, the working of the factories is very irregular and it is necessary to employ much additional labour during the height of the fruiting seasons. The prices paid for pines are somewhat high at the beginning and end of the seasons, but they are, as a rule, so low during the height of the May-June crop that the grower gets practically no profit.

There is usually a small supply of fruit available between the main cropping seasons, and the canner has to rely on this to keep his factory running during these periods. The supplies are usually supplemented by purchasing fruit from outside sources where the fruiting season does not coincide with that in Singapore, and fairly large quantities are shipped to Singapore from Port Swettenham : when it has to be transported such long distances, the fruit is cut just a little under-ripe. Towards the end of 1921 there existed about six canning factories in Singapore, two near Johore Bharu on the mainland, and one in Selangor.

STORAGE OF GRAPE-FRUIT.

The following extract is taken from the Report of the Porto Rico Agricultural Experiment Station, 1923.

For the last three years the entomologist has been trying to determine the best method of storing grape-fruit for home use. The fruit has been found to keep for a short time, say two or three months, in dry sand, sawdust, or cocount fibre, and for a longer period in moist sea sand or clear river sand, moist sawdust, or moist coconut fibre. The fruit should be thoroughly cleansed of scale before storing, otherwise it will break down as the scale increases. Two weeks after the fruit has been placed in storage it should be looked over carefully and the decayed specimens removed. In many instances, few decayed fruits were found in lots of grape-fruit that had been stored three and four months. The longest period of storage was 14 months, but losses began to occur after the fifth month. The varieties showed little difference in keeping qualities when the matured fruit was stored. Of the lots tried, Pernambuco had the best keeping qualities, with Marsh Seedless ranking second and Duncan third.

In order that the best results may be obtained, the fruit should be picked when it has reached its prime. This is true specially concerning the Marsh Seedless, the seeds of which will sprout soon after the mature fruit is placed in storage. The Duncan variety, when fully mature, seems to hold up better than does the Marsh Seedless, the flesh retaining its normal colour and fine eating qualities, and seeds not sprouting so quickly. Fine-skinned fruits were found to remain in good condition longer than those with coarse skin. Sprouting seeds are often found in fruit which remains too long on the tree, say from 14 to 16 months, and the seed of mature fruit sometimes sprouts after a rain follows a long drought.

Clean, moist sand or sawdust is probably the best material in which to store grape-fruit for home use. Dry sand may be used, but fruit shrinks when stored in it a short time. Storing grape-fruit for short periods in dark, moist chambers gave satisfactory results, the fruit not shrinking for two or three months. Shrinking occurred when the fruit was stored for six months in the open in moist chambers, but not when it was stored for the same length of time in moist coconut fibre in moist chambers. Heavy losses, due to sun and rain, occurred in about 500 grape-fruits which were stored in coconut fibre in the open, and at the end of three weeks a lot of 30 cases of loose oranges showed a decay of 66 per cent. when stored in coconut fibre in the open.

Cockroaches, which considerably damage stored fruit, may be held in check by the use of roach pastes. Grape-fruit when stored should be well protected from rats.

FODDERS.

SOME OF THE WIDER ASPECTS OF THE FODDER QUESTION IN INDIA.

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The fodder question, like the cattle breeding question, is seldom properly understood in its wider aspects. In spite of the obvious fact that it is largely one of economics, there are many who consider that it can be solved by propaganda work. Such cries as "Encourage fodder production," "the people must put larger areas into fodder crops" assume that the cultivators wilfully neglect their cattle or that there exist large areas in India where crops can be grown purely for cattle fodder. The fact of the matter is that where holdings are large enough special areas *are* put under fodder, and the cattle *are* well fed and well kept. The great masses of the population in India, however, exist on small holdings. The cultivable area is devoted to and in most cases is just sufficient to meet the food requirements of the people, to pay rent or land revenue, and purchase the necessities of life, and it is the crop residues which form the main diet of the cattle of the country. This is to a certain extent true of other and more prosperous countries, but the extent to which crop residues form the diet of Indian animals is far greater than in most.

The reason, of course, is not far to seek. Animal industry, that is to say, the production of animal as distinguished from vegetable products, is less important in India than in most countries. There is no beef eating, and dairying has yet to be developed in the arable districts, where it is practically non-existent except in favoured tracts such as Gujarat, the Punjab Canal Colonies, etc.

The crop residues referred to consist for the most part of the leaves and stems of the grain crops, the "cakes" produced in the oil pressing industry, and lastly, but by no means unimportant, the cotton seed after the lint has been extracted.

It will thus be readily realized that the cattle of the country are materially affected by improvements or the reverse in the staple crops of the country. It may be said at once, that, other things being equally an improvement in the yield of these crops will be felt by the cattle just as much as by the human population. The growing of more efficient varieties of the staple crops, the improvement of yield by manuring or by improvements in cultivation, will effect a corresponding increase in the food of the cattle.

Conversely, the cattle may be adversely affected by a deterioration in the yield of the principal food crops, the growing of new varieties for grain purposes with no corresponding increase of straw, the growing of high lint percentage of cotton without an increase in total outturn of *kapas* (seed cotton) or the growing of crops yielding straw inferior as regards either food-content or digestibility.

The importance of this point of view may be seen from the crop statistics of the country. Taking the average straw to grain ratios in the case of rice and wheat we find that the combined yield of straw from these two food crops amounts to not less than 90 million tons per annum. The straw outturn from the 50 million acres of *jowar* (*Andropogon Sorghum*), *bajra* (*Pennisetum typhoideum*), and gram for food for human consumption runs into enormous figures.

Compared with such figures, the amount of fodder grown specially for cattle feeding is relatively small. At the same time the importance of supplying green fodder as a mixing ration to straw is well understood and, wherever possible, grass, weeds, etc., are cut for this purpose. To some extent, especially in North-west India, cold weather leguminous crops such as melilotus, lucerne, etc., are grown as catch-crops when the cover-crop ripens too late to permit the growing of a *rabi* crop.

It is, however, the rice growing areas which are badly off for green catch-crops, and it may be here noted that the smallest and worst-conditioned cattle are found in these tracts. There the animals subsist almost entirely on paddy straw supplemented by the scanty stubble grazing available in the dry weather, and, in the rains, by what grass can be obtained from the field bunds, etc. The rice straw offers a bare subsistence ration for cattle at rest. As a working ration it is below par, and if it were not for the fact that the cattle in the tracts referred to have not more than a month's hard work in the year, *i.e.*, in the puddling season, the situation would be quite impossible.

The improvement of the cattle in the rice areas is admittedly one of the most important of problems, which at one time appeared to be insoluble without cold weather irrigation. Recent work has, however, demonstrated the existence and importance of vitamines in the diet, and it now appears possible that the addition of quite a small quantity of the right class of green fodder to the rice straw ration might appreciably leaven the whole. The study of the value of different green crops for mixing purposes might thus yield valuable results applicable to the rice tracts. So long as the amount of green fodder required is small enough to permit of its being grown under well or tank irrigation, there need be no great difficulty for most cultivators to keep a very small patch of, say, lucerne, or some such fodder going all the year round for the sake of the cattle. If, on the other hand, any considerable area is required, then the question can, as far as one can see, be solved only through increased irrigation facilities.

Apart from the general point of view of the maintenance of the working cattle of the country, there remains the important subject of dairying. This is the only form of animal husbandry, in its true sense, possible in an "agricultural" country with a vegetarian population. Commercial dairying is, however, only possible where plenty of green fodder is available during the greater part of the year. The rice tracts, therefore, are ruled out for this industry, but there remain very extensive high land irrigated areas where dairying is not only possible but ought to be profitable at the present rate for dairy produce. In these tracts the work cattle are on the whole good, but in many places a buffalo population for ghee-making has sprung up and is now competing for the fodder—a state of affairs which can only be overcome by careful breeding of cattle for dual purposes of milk and

draught. There is, however, a wide field for profitable investigation as regards the yielding power of different fodder crops in these areas, both for their relative feeding values and the economics of manuring. There is no more promising field so far as yield is concerned for manuring than in its application to the fodder crops.

Summarizing, I should therefore recommend to the Conference the special importance, from the point of view of the cattle of the country, of—

(1) The straw produced by the improvement in grain yields either through the new varieties, improved cultivation, or manuring, both as regards quantity and feeding value.

(2) The production of green fodder for mixing purposes.

(3) The production of fodder for dairy cattle.

—Agricultural Research Institute, Pusa Bulletin, No. 150, 1923.

BROOM CORN—A NEW FODDER CROP.

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Three varieties of Broom corn (Standard, Acme and Dwarf) received from the United States have been tried at Karimganj, Shillong, Jorhat and the demonstration Farm at Haflong Hill. The results obtained may be summarized as follows:—

1. Karimganj. All the varieties grew fairly well. Both the Acme and Dwarf showed a good growth, suitable for silage or for feeding green to cattle. The yield of fodder was roughly about 250 maunds per acre.

2. Haflong. All the varieties grew very well, far better than on the Karimganj Farm. As the fodder problem does not arise at Haflong, the crop could be grown for grain like *jowar*.

3. Shillong. The Broom corn was planted in the same field with maize, but the plants showed a very poor growth and were very late in maturing.

4. Jorhat. All the varieties grew as vigorously as in the southern parts of the United States of America. The standard attained a height of about thirteen feet, while both the Acme and Dwarf showed a luxuriant growth. The yield of fodder was roughly about 200 maunds per acre.

Further trials will be made next year. As broom corn, especially the Acme and Dwarf varieties matures for fodder in two months, it may prove useful as an early fodder crop in the Assam Valley. The straw can be used for brooms and brushes for which there is always a demand.—Agricultural Research Institute, Pusa, Bulletin No. 150, 1923.

Block by Survey Dept. Ceylon.

ALYSSICARPUS VAGINALIS.

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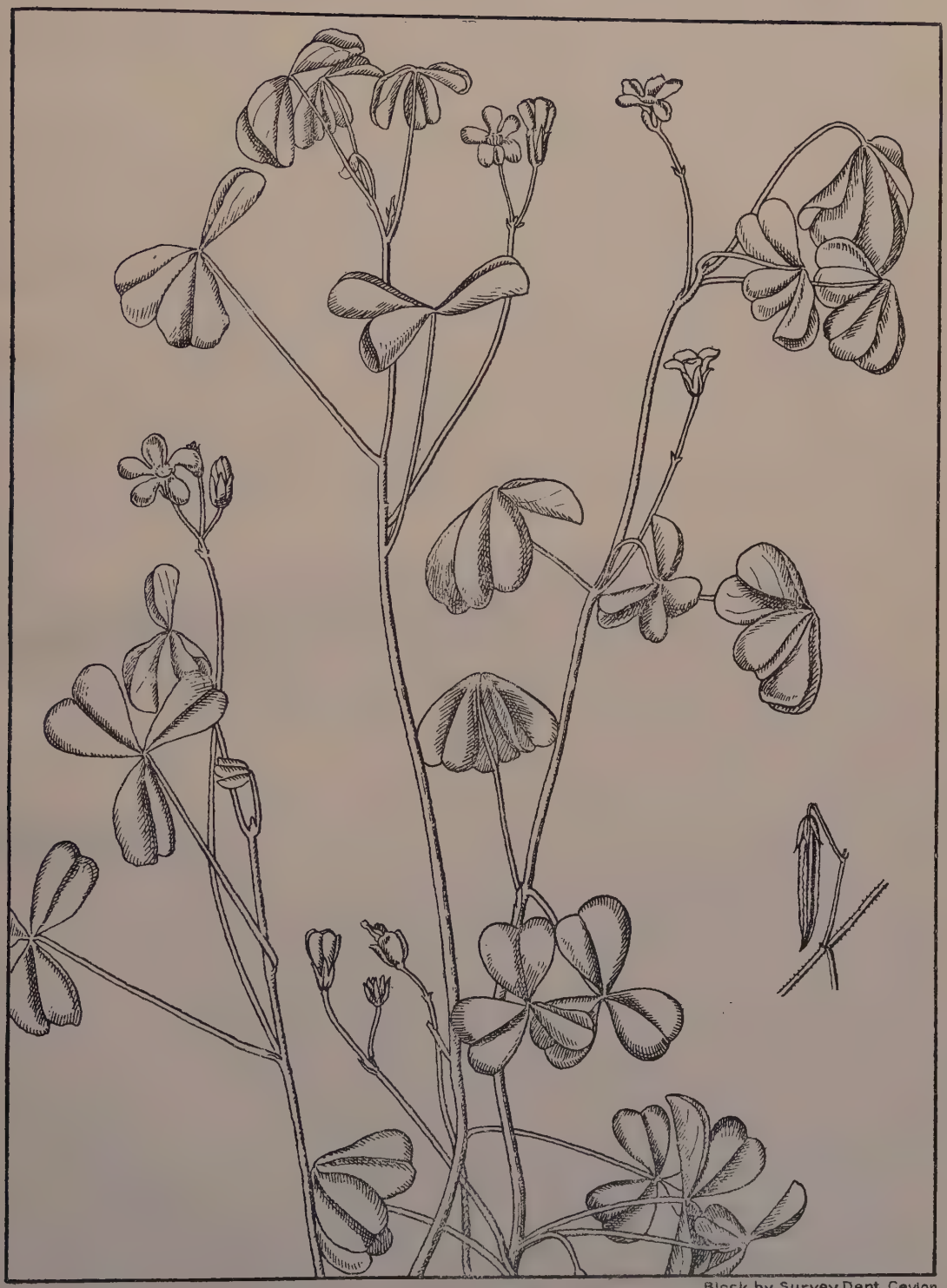
ROTHIA TRIFOLIATA.



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OXALIS CORNICULATA.

SOILS AND MANURES.

COVER PLANTS.

T. PETCH

Alyssicarpus vaginalis DC.; Sinhalese Aswenna (Plate VII).—This plant has been sent in on several occasions from coconut estates where it sometimes grows in quantity, especially in the drier districts. It is more or less erect, dividing into numerous stems from the base, and attaining a height of two to four feet. The leaves are simple, oval or narrow, whitish and hairy underneath. The plant flowers in December and January, the flowers being pinkish violet. It belongs to the Leguminosæ, and has the usual pea-shaped flower.

This plant would scarcely afford sufficient material to be used as a green manure, if any larger species could be grown. It might, however, be useful in the drier coconut districts, if difficulty was experienced in establishing the better-known leguminous species.

Rothia trifoliata Pers. (Plate VIII).—This is another species which is commonest in the drier districts in sandy places. It is much branched and spreads over the surface of the ground, and consequently would serve as a cover-plant. The leaves consist of three rather small leaflets, about half an inch long, hairy on both sides. The flowers are small, but pea-shaped, pale pink in colour. The plant is an annual, and belongs to the Leguminosæ.

Oxalis corniculata L., Sinhalese Hin-embul-embiliya (Plate IX). This plant has been recommended in South India for the prevention of soil erosion, or rather, it is one of the plants which, it is advised, should be allowed to remain when weeding selectively. It is very common in Ceylon, especially on cultivated ground, and often invades flower pots on the bungalow verandah. It is one of the plants to which the name of Shamrock is applied in this country. It grows over the surface of the soil with long creeping stems, which root at intervals and give off sub-erect branches. The leaves consist of three leaflets, like clover leaves. One variety has deep brown leaves, and this form is sold as a pot plant in temperate climates. The flowers are yellow, regular, funnel-shaped, with five petals and ten stamens. The seed pod is long and has five ridges; when ripe it explodes if touched.

This species of *Oxalis* does not form bulbils, and consequently it is not difficult to eradicate, like the rose-purple flowered species, *Oxalis corymbosa* and *Oxalis latifolia*. Its roots are sometimes thickened, but this is immaterial as it does not propagate by its roots. It is spread by seeds, which are produced freely. The leaves are much smaller than those of the introduced species which have hitherto been regarded as harmful weeds.

HYGROSCOPIC MANURES.

As is well known, many substances absorb moisture from the air. A familiar example is the "common salt" of our tables, and there are many other salts, in the chemical sense, which have the same property. Such substances are said to be hygroscopic. This property is not confined to what are generally known as chemicals. Crude rubber is hygroscopic, and so are horn and hair. The ordinary hygrometers, instruments which measure the humidity of the air, are usually worked by a bundle of hairs.

Hygroscopic substances will take up moisture, not only from the air but from anything damp with which they may happen to be in contact. Thus when a hygroscopic manure is broadcasted over a field, and disappears in a night in the absence of rain or dew, it may safely be assumed that it has obtained the moisture in which it dissolved chiefly from the soil. Quite a different result would be obtained if it were exposed on a plate. It is known that when a hygroscopic manure is drilled in with seeds, the germination of the seeds may be delayed because the manure abstracts the moisture from the surrounding soil.

Some hygroscopic substances continue to absorb moisture until they become liquid. These are said to be deliquescent. Obviously the two terms are not synonymous. It is not the case that every hygroscopic substance is deliquescent. Hair does not deliquesce. Sulphuric acid, which is very hygroscopic, cannot deliquesce because it is already liquid. Lime is hygroscopic, but not deliquescent. Calcium chloride, on the other hand, which is commonly used as a drying agent, is not only hygroscopic but strongly deliquescent.

In some instances, this quality limits the usefulness of a chemical, and causes notable differences in the utilisation of two substances, which, for some purposes, are considered more or less equivalent to one another. For example, potassium nitrate, common saltpetre, is used in the manufacture of gunpowder, but sodium nitrate, Chili saltpetre, cannot be used in gunpowder, because it is hygroscopic.

In considering this subject from the practical point of view, we have also to take another factor into consideration, namely, that many substances which are not hygroscopic in a pure state, are hygroscopic in the state in which they are generally handled by the consumer. For example, the useful ingredient of common salt is sodium chloride. But sodium chloride is not hygroscopic, while common salt is. The explanation is that ordinary table salt is not pure sodium chloride, but contains other substances as well, and it is these impurities which are hygroscopic. Common salt is a mixture, though pure enough for human consumption. Consequently, the individual who seeks to be facetious and requests his neighbour to "pass the sodium chloride" is merely indicating his lack of knowledge.

This brings us to another point which is seldom understood except by those whose business compels them to become acquainted with chemicals. Pure chemicals, if not rarities, are decidedly expensive articles. The chemicals used in manures are impure, and consequently they are purchased with a guarantee that they contain a certain percentage of the substance

whose name they bear. They are good enough for the purpose, and further purification would add to their cost. Leaving those as outside the pale, the ordinary catalogue of chemicals begins by offering what is called a "commercial" grade, *e.g.* one corresponding to the ordinary grocer's grade of washing soda, at a fairly low price. Such a grade has only a limited use in a laboratory. But by paying four or five times the price, one can obtain a pure grade, which however, is not necessarily pure, but, like common salt, only pure enough for certain purposes. A pure chemical may be quite pure enough to be used in medicine, but useless for analytical purposes. At a higher price still, however, one obtains a grade styled "puriss," which we take it means purissimus. But even that is not the limit; for critical work in the cultivation of fungi or bacteria, one has to buy "guaranteed" chemicals, which are purer than the purissimus. And one can go further still in some cases, and purchase a grade prepared by a special method which gives a greater purity than any other. The classification of chemicals is only paralleled by the classification of eggs,—eggs, cooking eggs, fresh eggs, new laid eggs, dated eggs.

The point to be borne in mind is that all chemicals which are sold in bulk at a comparatively low price are necessarily impure, and their properties may be modified by the impurities they contain. It may be quite correct to state that a given substance is not hygroscopic, but yet the commercial product which passes under that name may be, because of its impurities. Again, it may be true that two pure chemicals can be mixed without any change occurring, but still it may not be possible to mix commercial grades of those chemicals. Thus, a knowledge of pure chemistry may prove misleading when commercial grades are being dealt with.

It is well known that certain chemicals used in manures cannot be mixed without a loss of nitrogen, and that others cannot be mixed because the mixture becomes hygroscopic or deliquescent. In Ceylon, it is customary for those responsible for the management of estates to prescribe the manures which are to be applied and to forward the prescription to the manure merchant. It will be evident from what has been written above that there is considerable opportunity for mistakes; and the question arises whether in such cases the manure merchant should point out the defects of the prescription as regards the hygroscopicity of the mixture. From his experience with manures, he should know what will happen when the mixture is made up. Moreover, as manures of the same name may be obtained from different sources, their impurities may differ, and only the manure merchant knows what the impurities are. Consequently, he is in the best position to know whether the mixture can be made as ordered, from his stock.

An exact parallel frequently occurs in medicine. There are many drugs which cannot be prescribed in the same mixture. Technically they are known as incompatibles. But it often happens that in the hurry of the moment a doctor will prescribe incompatibles. The druggist who is asked to make up the prescription naturally detects this, and it is the invariable practice in such cases to communicate with the doctor and have the error corrected.

Experience shows that, in Ceylon, some, at least, of the manure merchants will make up any mixture asked for, regardless of the compatibility of the ingredients. We would suggest that this is not good business even from their standpoint, and the medical custom might well be copied.

To avoid the mistakes referred to, it is often recommended that use should be made of a diagram which has recently been published in Ceylon under the name of Dr. Geehen's Chart. This diagram has the shape of a polygon, the names of the manures at the corners, with cross lines indicating which manures can, or can not, be mixed. The first of these diagrams was originally published in Germany, and it was devised, we believe, with the object of showing which manures could, or could not, be mixed without loss of nitrogen. There are now numerous versions, and, in endeavours to make it correct, it has in some cases been modified to such an extent that its inventor would not recognise it.

But if one consults standard works on soils and manures, he will find that, although it has been known for some twenty years, there is no mention of Geehen's Chart. And the probable reason of the omission is that it does not work. As regards its original purpose, *i. e.* to indicate loss of nitrogen, it is, we believe, correct, but it has been proved to be wrong as regards other chemical actions, and it is quite wrong as regards hygroscopicity. One has only to make a few trial mixtures of the manures which the chart indicates as miscible, to find out that, in the matter of hygroscopicity, the chart does not work in Ceylon.

While dealing with this subject, reference must be made to an extraordinary piece of pseudoscience which has gained currency in Ceylon, *viz.*, that if a hygroscopic manure is applied in dry weather it will absorb moisture from the air and thus help the plant through a drought. It has already been pointed out that when a hygroscopic manure is in contact with the soil, it will take moisture from the soil. Apart from that, however, the quantity of moisture absorbed by the manure is quite insufficient to make any difference to the plants. Suppose, for the sake of illustration, that the manure absorbs from the air an amount of moisture equal to its own weight. Then 1 cwt. of the manure per acre would absorb one hundredweight of water per acre. Now 1 inch of rain is roughly 100 tons to the acre, so that 1 cwt. of water per acre is equivalent to a rainfall of ·0005 inches.

As stated by Hall, "The extra amount of moisture that could be held in the soil by a few hundredweights of nitrate of soda would be wholly imperceptible when distributed through the hundred tons or more which the top inch of soil weighs per acre."

Moreover, the solution formed by deliquescence is a concentrated solution. If the roots of a plant are placed in a dilute solution, the plant absorbs the solution, but as the concentration of the solution is increased, a point is reached at which the solution takes water from the plant. Consequently, if a highly concentrated solution comes in contact with the roots of a plant, the roots may be injured.

ARTIFICIAL FARMYARD MANURE.

PROFESSOR F. HARDY, M.A.

In the last issue of this Journal, a description of the preparation of pen-manure by the Mauritius method was given. In this process of making manure, the urine of farm animals is employed as a bacterial starter. Its addition to cellulosic litter, such as straw or cane-trash, enables certain organisms that are capable of decomposing cellulose to get to work and to multiply. Mention was made in the article cited of another method of making pen-manure in which even a urine starter is omitted. This method is the Rothamsted artificial manure process, now known as the Adco process. The starter employed is ammonium sulphate. This is added in solution to cellulosic material which has previously been soaked with water. In order to neutralize acidity that develops as the ammonium sulphate is utilized by the cellulose-decomposing organisms, calcium carbonate (ground limestone) is previously mixed with the material. Recent information indicates that the Adco process has more than realized anticipations in England. It is of interest to tropical agriculturists to note that successful attempts have now been made to apply the process to the manufacture of artificial pen-manure from sugar-cane trash. The following information on this point is taken mainly from the *Australian Sugar Journal*, for April 4th, 1924.

As a result of correspondence, the Scientific Staff of the Agricultural Developments Company of Harpenden, Herts, agreed to experiment with cane-trash as raw material for making artificial pen-manure. The experiments successfully demonstrated that a satisfactory product could readily be prepared from trash. This product compared favourably with ordinary English farmyard manure when tested in pot cultures. Furthermore, its analysis showed that it was even superior to Adco manure made from straw, in nitrogen and potash-content, and in content of organic matter, though somewhat inferior in phosphate. In 1923, the Adco Company shipped to Queensland, 10 tons of their standard Adco mixture*, which is sufficient to produce 400 tons of artificial manure from 150 tons of dry cane-trash. This mixture costs £21 per ton c. i. f., delivered in drums at Brisbane. The Adco Company is prepared to grant licences to work their process, as protected by their Australian patent. Large scale trials are being carried out in Queensland, in order to determine whether or no the process is practically advantageous when applied to actual sugar-cane growing. The results of these trials, and of others that are doubtless being attempted in other parts of the tropics, will be awaited with great interest.

A brief history of the Adco Company is not out of place at this juncture. The Rothamsted researches on cellulose-decomposing organisms were commenced by Dr. H. B. Hutchinson in 1917. They were briefly mentioned by the Director of the Rothamsted Station, Sir E. J. Russell, in the August

*The composition of this mixture is not divulged. Presumably it consists mainly of ammonium sulphate and calcium carbonate, since it is stated that all that is required in addition is a supply of water that can be suitably sprayed over the trash heap. The information explains that it is necessary in the process to supply "certain chemical stimulants" for "bacterial growth" in order to obtain the be conditions for rapid cellulose decomposition.

Number of the *Journal of the British Ministry of Agriculture* for 1919, and again in the August Number of the same Journal for 1920. A more detailed account of the work was given by Dr. Hutchinson and Mr. E H. Richards in the August Number of the Ministry's Journal for 1921. Field trials at Harpenden and Woking with artificial farmyard manure prepared under the direction of the Rothamsted workers had given satisfactory results for three consecutive seasons. Consequently, in 1921, in order to foster the employment of the process in practical agriculture, and to tide it over the difficult stage between the laboratory and the farm, Lord Elvenden generously provided the funds for the formation of a company, whose primary object as stated, is not to make profits for the benefit of its shareholders, but to try to develop as a business the manufacture of artificial farmyard manure from waste straw and similar material. The company was organized under the name of The Agricultural Developments Company (Pryford) Ltd., of 12, Spencer Road, Harpenden, Herts, England. The Managing Director is Mr. E. H. Richards, B. Sc., F. I, C.

To quote Lord Elvenden, "It has always been my ambition to see whether it is not possible to make certain branches of scientific research self-supporting; and since any progress to this end requires the employment of a qualified staff, and the purchase of mechanical plant, persons participating in the advantages of the process may quite fairly be expected to contribute to the cost of development by a reasonable payment, either in the nature of a royalty, or otherwise. The royalties will be available after payment of expenses to form a fund for further scientific research along practical lines in agriculture."—Tropical Agriculture, Vol. I, No. 9.

EROSION AND SURFACE RUN-OFF.

In the Missouri Station Research Bulletin, No. (1923). Messrs. F. L. Duley and M. F. Miller have recorded the results of an investigation into the problem of erosion and surface run-off under different soil conditions. The following summary of their work is taken from Experiment Station Record, Vol. LI, No. 3.

Experiments covering a 6-year period are described, in which the amount of run-off and soil eroded were measured after each rain from seven plats having different cropping systems or tillage treatments. The plats, which were each 1·80 acre in area, were elongated in form and ran up and down a slope averaging 3·68 ft. to 100 ft. Concrete tanks at the lower ends served to collect the run-off and eroded soil from each plat. Each plat was given a different treatment, which included (1) no cultivation with all weeds pulled, (2) 4-in. spading in the spring and cultivation after rains, (3) 8-in. spading in the spring and cultivation after rains, (4) blue-grass sod, (5) wheat annually, (6) a rotation of corn, wheat, and clover, and (7) corn annually.

The average run-off varied from 48·92 per cent, of the rainfall on the uncultivated plat to 11·55 per cent. on the blue-grass sod plat. The land spaded 8 in. deep in the spring absorbed only 2·9 per cent more rainfall than that spaded 4 in. This is taken to indicate that deep ploughing of farm lands can be expected to have only a slight advantage over shallow ploughing with reference to the absorption of rainfall. Uncropped land, whether cultivated or uncultivated, absorbed much less water than grass or clover land. Land in rotation of corn, wheat, and clover lost only 14·14 per cent. of the rainfall as run-off. The surface inches of rainfall absorbed by uncropped land or by land growing a cultivated crop like corn was practically constant from year to year for a given soil condition, regardless of the wide variation in the annual precipitation. The absorption of sod, wheat and rotated land was more variable.

The average annual rainfall for the six years of the experiments was 35·87 in. or 1·73 in. below normal. The seasonal distribution of rainfall was also somewhat below normal during the winter and summer months and above normal during the spring and fall months. The times of maximum run-off and erosion were during March, April, August, and September. On plats 2, 3, 4, and 6 more than 50 per cent. of the erosion took place during August and September. The annual erosion from spaded land where no crop was grown was greater than from soil which was not stirred.

Deep spading reduced the loss from erosion only 13·4. per cent. as compared with the shallow spading. This is taken to indicate that deep ploughing is less effective in controlling erosion than is usually supposed. In addition, the total loss from the deep-spaded land without a crop was very high as compared with cropped land. The presence of a corn crop reduced the erosion of deep-spaded land by 50 per cent. as compared with the uncropped land, wheat reduced it 81 per cent, and rotation 93 per cent. Sod land lost only 0·68 per cent. as much soil as the uncropped soil spaded 4 in. deep.

A direct correlation of the amount of soil eroded with the number of heavy rains occurring during the year showed that the soil eroded during 16 of the most destructive rains in the six years under consideration was more than 50 per cent. of the total erosion on five of the seven plats.

Chemical analyses showed that the amounts of nitrogen, phosphorus, calcium, and sulphur in the eroded material from corn or wheat land may equal or exceed the amounts taken off in the crops. Only small amounts of nitrogen were lost as nitrates in the run-off water. Mechanical analyses showed that the material eroded from the bare and the cultivated plats contained a higher percentage of sand and a lower percentage of fine material than the soil lost from the other plats.

The results as a whole are taken to indicate that much can be done in the Corn Belt toward reducing run-off and the disastrous effects of erosion by planning crop rotation in such a way that the land will be covered with a growing crop a very large portion of the time.

PESTS AND DISEASES.

DIEBACK OF HEVEA CAUSED BY A BUG.

DR. W. BALLY.

(*Translated from the Dutch by H. L. Ludowyk, Librarian, Department of Agriculture, Peradeniya.*)

In a short article Leefmans has lately shown that indigenous insects may suddenly attack cultivated plants, introduced from elsewhere, which they did not know before as food-plants. We may add to this list a new example of an insect pest of *Hevea* which, up to now, has not been described. Since, perhaps, of no single cultivated plant have the diseases and pests been so closely observed and described as of *Hevea*, it seems very improbable that this pest has hitherto appeared elsewhere in serious proportions. The estate on which we observed the damage two years ago lies rather isolated in the Zuidergeberte and adjoins secondary forests from which, probably, the infection took place.

EXTERNAL APPEARANCE.

The administrator of the estate referred to, which we shall call A, repeatedly reported the occurrence of Dieback. We considered at first that it might be one of the doubtful Dieback diseases caused by *Gloeosporium* or *Diplodia*, but the exterior of the withered branches showed very little agreement with the known illustrations of such diseases.

The withered branches bear brown, oblong, sunken patches, 1 to 2 centimetres long and ½ to 1 centimetre broad. The brown discolouration on the green branches is caused by a formation of cork; the same phenomenon occurs also on the scars of the fallen leaves, but these are clearly differentiated by their regular shape from the brown wound-spots. The earliest stages are simple small blackish depressions, the majority of which occur on places where the tissues are particularly sappy, especially in the axils of the leaves where the young resting buds are found, or on the swelling at the base of the leaf-stalk, and at the junction of the leaflets. With the growth of the young branches these spots naturally undergo changes in appearance. In an older stage, the main branch is quite dead, its functions being carried on by side branches which grow up vertically.

A shoot on which many brown spots occur generally dies from above downwards, the terminal bud being withered and often split, and the leaves becoming brown and finally falling. The Dieback may then extend downwards; and it has happened that a small young tree has died completely. Generally, however, lateral branches arise and replace the dead main shoot.

On the only estate where this pest has so far appeared, a small plot of budded trees in particular, that, for the purposes of bud-wood production, was very closely planted, suffered severely. But other trees up to five years old were found, scattered over the whole estate, on which the same phenomena occurred.

INTERNAL CHANGES.

If we cut through a heavily infected branch, we can, even with the naked eye, distinguish both on the cross and on the longitudinal section, brown stripes, which traverse the bark in all directions, and in some cases penetrate the wood ring and run through the pith both horizontally and vertically. Where the attack is very old, holes and galleries have been formed, by a rotting process, in the pith, and these, at first sight, resemble insect borings.

A microscopical examination, however, soon brings us to another opinion. The thin brown stripes which are found exclusively in the early stages are caused by the deposition of a particular substance between the cell walls. The initial stage is characterised by the appearance of yellow grains and stripes in the middle lamella. The cell walls then become light yellow, and subsequently dark brown. The death of the cell contents occurs much later and is restricted to a few cells.

As Busgen and, after him, Zweigelt, have shown, the substance which is deposited in the punctures made on plants by sucking insects is coloured red with Millon's reagent. Busgen and later workers who have investigated this consider that this substance is the salivary fluid secreted by the insect. Zweigelt has further shown that this substance is coloured red by safranin, and that it absorbs the blue colour from a very dilute solution of Methylene Blue.

He has further shown that saliva is injected during the penetration of the proboscis. Since on further penetration the proboscis is immersed in this secretion, a sheath is formed which can always be recognised later, by the reactions above described, as originating from the puncture of a sucking insect.

The galleries and stripes already described were coloured red by safranin, and the coloration with Methylene Blue was also very distinct after 24 hours. The reaction with Millon's reagent was not always equally evident; sometimes it was difficult to say whether the change in colour of the original yellowish-brown stripes should be called dark red or dark brown. We should not forget, however, that the cases investigated were, for the most part, old, and that thus changes had come into play, in which the cell walls of the host plant were also involved.

The brown and yellow stripes, which thus occur in consequence of the secretion of saliva, and the changes in the cell walls caused thereby, which, however tortuous their course may be, can always be traced back to their starting point, *i.e.* the brown spots on the surface of the branch, made us suspect that we had to deal with an injury caused by a puncturing insect.

THE INSECT, THE PUNCTURE WOUNDS AND THEIR CHANGES DURING THE GROWTH OF THE BRANCHES.

In the budded gardens that showed the greatest number of attacks, we found a well-known bug, *Dindymus rubiginosus*. This is a polyphagous species which made its appearance as an enemy of the coffee-berry boring beetle. Some time ago, Wurth gave the following description of this insect.

The wings when at rest lie horizontally on the hinder part of the body. The front wings have, as is the rule with bugs, a leathery part at the base,

while the tip is membranous and transparent. Behind the scutellum is a black triangular spot. The base of the wings, the thoracic segment, and the head are of a bright orange colour or the colour of red lead. At the hinder edge of the thoracic segment there runs a white band. The antennæ, the proboscis, and the legs are black. The antennæ and the proboscis are four-jointed. The proboscis when at rest lies pressed against the under side of the body. The body is black underneath, with the exception of the brownish-yellow hinder part and three snow-white longitudinal stripes. The female may be about 15 millimetres long; the male is somewhat smaller.

In order to make certain that the symptoms already described are really attributable to the puncture of *Dindymus*, experiments were undertaken. The tops of some young trees were enveloped in net cages, in which one or more specimens of *Dindymus* were liberated. Most of the experiments unfortunately failed owing to the death of the bugs; in some cases we were able to find numerous fresh punctures, but the later course of the attack was different from that on estate A. We never found the dark brown spots on the epidermis, nor the brownish-yellow stripes in the tissues, of our experimental trees.

These experiments should therefore be repeated most preferably on estate A. It is quite possible that in our experimental garden, the conditions under which the trees grow are of such a nature that the punctures heal sooner and do not develop to such an extent as on estate A. Though the result of our experiments is not satisfactory, numerous observations of sucking *Dindymi*, both in the gardens of A as well as in the laboratory, and the fact that these insects are to be found especially on the spots from which the internal phenomena of the disease spread, namely at the joints of the leaves and at the dormant buds, convinced us that *Dindymus* or a related kind of bug must be held responsible for the disease phenomena which have been described.

The puncture is always effected on the sappy and growing parts of the plant. It is evident that if we investigate very old injuries, which we have most opportunity of seeing, we must take into consideration the fact that the punctures undergo changes through growth. Thus, as a result of increase in length, the original puncture, which could not be much longer than the proboscis of *Dindymus* (6 to 9 millimetres) or of some other bug, is drawn out considerably, so that we often meet with canals several centimetres in length. As a result of growth in thickness, the original very small intercellular passages enlarge in a tangential direction.

But these changes caused by growth are certainly not sufficient to explain the occurrence of a network of brownish-yellow galleries which traverse the bark, cambium, wood and pith in all directions.

The supposition of Zweigelt, which is probably correct in this case too, that the saliva which is injected goes beyond the extremity of the proboscis, may also serve as an explanation. But we must then yet further suppose that from these places a slow and gradual infiltration of the poisonous components of the saliva takes place between the walls of the surrounding tissue. The question whether the progress of the infection should be ascribed only to the slow penetration of the poison that is exuded from the

mouth-parts of the bug, or whether bacteria play a part in it, we must leave unanswered provisionally. Phytopathologists who are concerned with *Hevea* know of a similar progressive change of cell walls in Brown Bast, where the pathological changes of the cell wall and the yellow granular secretion between the walls may spread from a definite place of original infection to great distances.

THE ECONOMIC SIGNIFICANCE OF THE PEST: CONTROL MEASURES.

As already stated, up to the present time this pest has been observed on Estate A only. Here, however, it occurred in nearly all the gardens, sometimes few, sometimes many cases. The conditions for the growth of *Hevea* on the estate in question cannot be called exceptionally favourable. It is possible that on other estates where *Hevea* is under better conditions, the healing power of the tissues is greater and therefore the wounds close up quicker.

On A the damage sometimes appeared very serious. When we returned to the same fields after some weeks the replacing shoots had developed without damage, and the trees again appeared quite healthy, being in fuller leaf than trees which were never attacked.

However, this pest appears serious enough not to be overlooked. When we consider the economic loss that *Helopeltis* causes to Tea, Cinchona and Cacao, then we must certainly not regard the fact that another bug can attack *Hevea* as unimportant.

There is as yet little to say regarding the eventual combating of the pest, since we still know scarcely anything of *Dindymus* except the fact that we have to deal with a polyphagous insect which takes both animal and plant-food, and since we have no certainty that *Dindymus rubiginosus* is the only bug which causes the damage described. It was noticed by the Administrator that in the budded gardens the attacks were fewer when the Kapok trees that stood just next to them were cut down. The Administrator further believed that the pest occurred less heavily during the rainy season than during the East Monsoon.

As long as the pest occurs only in nursery beds or in young plantations, some success can be achieved by systematic trapping and searching. In older plantations this is naturally impossible, but here, owing to the nature of things, the attack will probably not assume such alarming proportions. Only young shoots are killed, and, in place of these, numerous side shoots always arise.—Mededeelingen van het Proefstation Malang, No. 49.

NOTES ON COTTON STAINER CONTROL.

C. L. WITHYCOMBE, Ph.D., D.I.C.

Before embarking upon the introduction and cultivation of any crop in a new country one has to consider, as far as is possible, not only the suitability or otherwise of the climate, soil, labour, &c,, but also the prevalence and likely influence of indigenous pests and diseases upon the production of such a crop. One has always to bear in mind the fact that in clearing land and planting a new crop the natural balance may be upset to a considerable degree and it is very difficult to foresee the consequences of such action.

It is in somewhat this position of uncertainty that we now find ourselves placed with regard to cotton. New lands for cotton cultivation must be found, largely owing to the ravages of various insect pests in the present cotton-growing countries, for example especially the Mexican boll-weevil in the United States and the pink boll-worm elsewhere. There remain, however, other pests which are almost equally important.

In all parts of the tropics and sub-tropics are found certain plant-bugs belonging to the genus *Dysdercus* and known commonly as cotton stainers. These bugs, in their natural state, live upon various wild Malvaceous plants but will readily leave this food in preference for cotton, which also belongs to the same plant group Malvaceæ. They have therefore always been associated with cotton and the popular name of stainer has been bestowed upon them from the fact that the lint of cotton bolls after puncture by these bugs is often found to be stained and rendered useless for commercial purposes. Nowell has shown that the staining is caused by several internal boll fungi and bacterial rots the spores of which are transmitted by the bugs when puncturing the cotton bolls for food.

The actual damage caused by the bug sucking nutriment from the cotton boll is without doubt important and experiments prove that the presence of cotton stainers is associated with a much higher percentage of shedding of the young bolls than is normal in non-infected plants. This direct damage is, however, totally eclipsed by the wholesale destruction wrought by internal boll rots, and it is for this last reason that the cotton stainer assumes such importance.

For the past year the writer has directed his attention to the study of cotton stainers in Trinidad, with a view to finding some effective control measures. The present note is merely preliminary outline of certain more general results. In Trinidad, cotton is grown only upon an experimental scale, but it is probable that results obtained under conditions here will be in many respects similar to those which would be obtained in other parts of the world, owing to the uniformity of life cycle and habits of these bugs.

As has already been mentioned, stainers can continue feeding and breeding upon various wild Malvaceous plants when cotton itself is not available and therefore one obvious method of control is to destroy wild food plants as far as possible in order that, in the close season for cotton, no food shall be accessible to the bugs, which should then die of starvation. This method is already in practice in several places and it is found to meet with a fair degree of success, but it is not always very practicable.

Observations in Trinidad, referring especially to *Dysdercus howardi*, show that stainers usually appear upon cotton when the bolls are ripening and not before. This observation itself is by no means a new one and many previous investigators have recorded similar occurrences in other parts of the world, but its full significance seems to have been somewhat overlooked. Thus it is suggested by some that the absence of stainers prior to the development of the bolls shows that the bugs cannot derive sufficient nourishment from the cotton sap alone but that they must have access to the seeds to breed successfully. While not denying that there is some truth in this suggestion yet the main point to which attention should be directed seems to be that stainers are not attracted in any numbers to cotton until the bolls are opening.

The writer's observations show that individual cotton plots or fields remain practically, and often completely, free of stainers until the bolls commence to open. Directly this happens an influx of stainers follows which is composed entirely of adults and of which a certain percentage are peculiar, as will be mentioned later. The insects have migrated to the cotton in response to a definite attraction which the cotton now exerts. Further enquiry shows that this attraction is due to an odoriferous substance which is given off from inside the boll and which is most effective when newly exposed, *viz.*, when the boll first opens. Attempts to isolate this attractive substance have met with some degree of success but it has not been possible as yet to determine its exact nature. It is quite probable that the whole cotton plant contains small quantities of the same substance distributed throughout but it is certainly concentrated in the boll and as a result the opening bolls are most attractive. Apparently the same thing holds for other Malvaceous plants, opening ochra pods having also been found to be highly attractive.

We now therefore know the reason for the sudden appearance of the stainers ; they have been attracted from elsewhere and are to be regarded as migrants which have apparently flown from localities near by where conditions were presumably less favourable. The latter part of this statement is made tentatively. In support of it may be stated, firstly, that stainers have been observed to fly frequently, although not more than twenty or thirty yards at a stretch in the daytime in Trinidad. But it is more probable that the insects generally migrate after sundown. In other West Indian Islands longer flights have been observed, and in the daytime. Young stainers, which are wingless, have not been observed among the migrants on cotton and undoubtedly do not migrate.

As regards the second point above-mentioned, that migration occurs from less favourable localities, it is known that stainers will leave localities where climatic or food conditions have ceased to be favourable, and unfavourable conditions seem to induce a migrating disposition in *Dysdercus*. If the migrants to cotton are examined they will be found often to consist largely of small, or dark-coloured, or otherwise non-typical forms. The production of these varieties does not seem to be subject to the ordinary Mendelian laws, but all breeding experiments point to their being produced by environmental conditions. On this point work is still in progress and it is in consequence not possible to give positive data, but as yet no peculiar "migratory" forms have been obtained when stainers have been bred upon cotton bolls under presumably good conditions, while on the other hand, the writer has succeeded in producing "migratory" forms by breeding from typical, pale, large *Dysdercus howardi* under what were calculated to be unfavourable conditions. Further evidence in support of the above assertions will be published later elsewhere; such is hardly within the scope of the present note.

Peculiar varietal forms which seem also likely to be correlated with environmental conditions have been noted in other parts of the world. Thus *Dysdercus discolor* (=*delauneyi*) of St. Vincent has a light-coloured form which may be of this nature. Several Nigerian species, *melanoderes*, *nigrofasciatus* and *intermedius*, seem likely, in the writer's opinion, to be merely forms of *D. superstitiosus*. Uvarov has shown similar varietal forms to be associated with locust migrations.

Summarising then the results of these preliminary investigations, it is seen that a newly planted cotton field, if sufficiently separated from sources of infection, will remain free of stainers until the ripe bolls commence to open. As soon as this occurs an influx of stainers will follow and henceforth these pests will continue to breed on the cotton until conditions cease to favour. The result on the cotton crop can easily be anticipated. The first pickings of bolls will yield a fair proportion of good and unstained lint, but subsequent pickings of bolls which have developed under stainer conditions, will be of progressively less value.

In cultural counter measures, then, one obvious aim would seem to be to select and grow a heavy cropping cotton which will produce a large first crop of bolls, the return from which shall be sufficient to clear a good profit. Later pickings may be expected to be of little value and the plants should be destroyed as soon as possible. A different crop must be grown next on the same ground so that no further breeding of stainers can occur. Young stainers, which are wingless, cannot migrate far.

Each new cotton field should be situated at some distance from any source of infection. The cotton has been shown to be not very attractive to stainers until the bolls commence to open and it may be mentioned that at a distance of two hundred yards from an infected plot of perennial cotton at the local Government Experiment Station a good and unstained first crop of bolls from Sea Island cotton was obtained. Not a single stainer was observed on this field until the bolls ripened. This distance of two hundred yards may prove to be sufficient elsewhere, but the point must be decided by actual experiment. It would be well to plant at too great, rather than at too small, an interval.

Perennial cottons do not seem to be advisable under conditions such as have been described, although they might possibly be utilised if cut down and thoroughly cleaned up after each crop. Generally, however, they serve as breeding grounds for the stainers at a time when few bolls are being produced and no real crop can be obtained.

Whether these suggestions are practicable ornot on a large scale, must await actual trial, but under the climatic conditions of Trinidad, at least such would seem to be the only solution for cultural control if cotton is to be grown at a profit. It may appear drastic to destroy a cotton crop immediately after the first picking and to reap all profits from this, but in the opinion of the writer this should prove to be a sound economic proposition, troublesome though it may be. Mr. L. H. Bird tells me that in the St. Vincent Experiment Station all plants are destroyed after the first picking and as a probable result higher yields and greater freedom from stainers are obtained here than elsewhere in the island.—Tropical Agriculture, Vol. I, No. 10.

SOME COFFEE DISEASES OF SOUTH INDIA AND THEIR CONTROL.

The following extract is taken from a paper, on the above subject, read at the Conference of the Madras Agricultural Students' Union, Coimbatore, by K. M. Thomas, Assistant in Mycology, and reproduced in the *Planters' Chronicle*, Vol. XIX, No. 41.

Kolê-Roga or Black Rot.—Next to "Rust" in importance comes "Black-rot" or "Kolé-roga" (*Pellicularia Kolêroga*). The Kanarese name "Kolêroga" which means "rot disease" is a happy choice in that affected bushes are easily recognized by the hanging masses of rotting blackened leaves often involving the clusters of fruits. In Southern India, this disease occupies only a secondary place to "Rust." While in its virulent form it is capable of greater and quicker damage than Rust, it is not capable of development except under very extraordinary weather conditions. The disease is prevalent in excessively wet and humid weather when the atmosphere is saturated with moisture. It is then most in evidence in the hollows of estates where the mist hangs for a great portion of the day and in other situations where there are no facilities for the free entry of sunlight and air. The damage caused is difficult to estimate but I have it on the authority of expert planters that the sporadic outbreak of the disease in the unusually heavy monsoon of 1923, caused a loss of about 20 per cent. of the crop in some localities in Coorg.

Control measures.—The spraying tests conducted by the department in recent years have positively proved the value of fungicides in preventing the disease. But spraying with its special limitations is not always a feasible weapon to deal with a widely spread outbreak, particularly as it happens in very rainy weather. A vigilant look-out for the centres of the outbreak, a ready stock of the materials and above all expeditious action, are essential factors for successfully combating the spread of the disease. A more rational and in practice a more successful remedy which is within the experience of practical planters consists in the regulation of shade, with a view to reduce the humidity in stagnant situations, by allowing the free entry of sunlight and currents of air.

Leaf-Spot and Die-Back.—Two other diseases commonly met with in the coffee plantation, which by the similarity of their appearance and effects are often mistaken for each other are "Brown eye spot" (*Cercospora coffiella*) and "Anthracnose" (*Colletotrichum coffeanum*). In old coffee their damage is negligible as compared with "Rust" and "Koleroga." They are reported from other coffee growing countries to cause considerable damage, but in South India their damage is not serious. They are responsible to a certain degree for the production of immaturely ripe and stained beans, but reports in the past regarding their damage were often exaggerated because a new disease now known as the "Black bean" was till recently attributed to these fungi. Of these *Cercospora* plays considerable havoc by attacking the nursery stock in all stages of growth either by killing them outright or reducing them to weakly defoliated seedlings. Experiments carried out in Coorg during the last two years have shown the marvellous effect which spraying can bring about in keeping the nursery diseases in complete check. The cost of such an operation works out to the paltry amount of 1 anna per 200 seedlings.

Root Diseases.—The root diseases of coffee have not been sufficiently studied in India. Every planter knows that he can check the spread of root diseases by common-sense methods. The ordinary procedure adopted consists in isolating the infected or suspected trees by a trench dug around them, pulling out the diseased ones and burning them *in situ*. Invariably the source of a root-disease could be traced to the jungle stumps left to decay on the plantations and the best method of preventing root-diseases lies in dealing with these decaying stumps before they begin to harbour root parasites.

A New Disease: "Black bean' or "jollu."—Before completing my catalogue of the important diseases of coffee met with in South India I think I shall not be doing sufficient justice to my theme unless I make at least a passing mention of another serious disease which has cropped into great importance in recent years. Apart from the light and immaturely ripe beans caused by defoliation or "die-back" of branches, several berries which though sound to all external appearances are spotted or stained within, are borne on perfectly healthy branches. In its simplest form there is merely a black spot on the silver skin (tegmen) of the seed. In a more advanced stage the tegmen is so completely stained that it affects the market value of the produce. In its worst form the meat is stained and shrivels up on drying or the whole contents of the berry become rotten with the formation of a brown liquid. The exact cause of this disease is still shrouded in mystery. All efforts to detect a pathogenic organism in it have so far failed. As far as our present knowledge goes it is prevalent in all coffee districts, but it occurs with varying degrees of intensity in different localities and in different seasons During a bad season the loss through this disease has been estimated at 25% of the crop.

FUMIGATION EXPERIMENTS FOR THE CONTROL OF THE CIGARETTE BEETLE.

The following extract is taken from the Report of the Porto Rico Agricultural Experiment Station, 1923.

The entomologist spent three months of the year in fumigating the warehouses and factories of the largest tobacco company in Porto Rico. Cigars and stored tobacco had become so generally infested with the cigarette beetle (*Lasioderma serricorne*) that all buildings in which tobacco is handled in the process of manufacture, including all workrooms, had to be fumigated. Fully 4,750,000 cubic feet of space was fumigated. The warehouses were treated with 40 ounces of sodium cyanid per 1,000 cubic feet for 48 hours.

The entomologist also assisted a continental concern in demonstrating the use of liquid hydrocyanic acid as a fumigant in two warehouses, both piped with one-fourth inch black iron pipes. In one of the warehouses which is 200 by 60 by 16 feet, the following plan was carried out: Pipes were run lengthwise through the centre of the building to the outer walls where they were connected with solution tanks. The pipe lines were raised about 9 feet from the floor and carried 6 or 7 spray nozzles that were directed toward the floor. When all was ready, the liquid was pumped under pressure into the pipes and evenly distributed through the building, being expelled through the spray nozzles in a mist which immediately turned to gas.

The operator must be as careful when handling tanks of liquid hydrocyanic acid as when fumigating by the pot or barrel method. Liquid hydrocyanic acid is twice as powerful as solid cyanid or cyanid solution, and will certainly cause trouble if the pipes leak. Considerable time is required to charge the machine in the liquid hydrocyanic-acid methods; but reckoning, weighing, handling of the material, and having to dispose of the residue, are dispensed with. The operator should not only wear gloves to protect his hands from painful burns, but he should also be provided with a gas mask in case of emergency. Commercial concerns should permit fumigation to be done only by a thoroughly efficient operator, such as a chemist, entomologist, or other person who is acquainted with the nature of poisons.

The method used for fumigating baled tobacco can also be used for Porto Rican cigars which have been packed for shipment. The gas penetrates the cigars and kills any insects present, regardless of their stage of development. Owing to the relatively humid air of Porto Rico, fresh cigars should be aired for three or four weeks, and others longer after being fumigated.

Fumigation was started about the middle of February, and although the work was not completed until about the first of June, losses due to returned cigars began to decrease in April. In April, statement from the New York receiving house to the San Juan office showed a saving of 40 per cent. over previous losses occurring in May and June (75 per cent. each). At the receiving house it was thought that a great proportion of the remaining 25 per cent. loss was on old stock which had not been fumigated. It is also possible that the cigars became reinfested in the New York storage terminal.

The New York house was not alone in reporting a decrease in loss. Selecting and inspecting room managers formerly had to discard as many as 10,000 wormy cigars in some months, and to employ a large force to examine every box, cigar by cigar, in which a wormy cigar was found. By fumigating their houses, tobacco companies have been enabled to cut expenses appreciably. Very few wormy cigars are now found in the factories.

CEYLON AGRICULTURE.

MATALE DISTRICT AGRICULTURAL COMMITTEE.

Minutes of a meeting of the District Agricultural Committee, Matale, held on 6th October, 1924, at 2-30 p.m.

Present.—Mr. T. A. Hodson, Assistant Government Agent (Chairman), Mr. G. G. Auchinleck, Divisional Agricultural Officer, Central; Mr. R. Senior White, Mr. N. K. Jardine, Plant Pest Inspector, Mr. W. A. Udugama, Ratemahatmaya, Matale South, Mr. D. B. Uduwawela, Ratemahatmaya, Matale East, and Mr. G. F. Abeykoon, Kachcheri Mudaliyar (Hony. Secretary).

2. *Minutes of Previous Meeting.*—The Chairman said the minutes of the previous meeting were not ready but that he hoped they would be submitted at the next meeting of the Committee.

3. *Register of Village Agricultural Requirements.*—Speaking on the resolution in his name, seconded by Mr. H. D. Garrick, Mr. Auchinleck, D.A.O., said, if it were possible for notes to be taken of agricultural needs of this district and submitted to this Committee periodically, it would help in keeping in close touch with the requirements of the villages of the district and also to help to get money spent more quickly in a useful way. If this record were kept at the Kachcheri he could send in notes for it and anything that came within the knowledge of a member could also be included. Such a record could be gone over at the meeting of a Committee and the results should prove beneficial to the district. He cited a case in Kegalle district where 400 to 500 acres of paddy were washed away and the people were unaware from where seed paddy could be got. All matters of interest could be recorded, such as irrigation, plant pests, etc. and allied agricultural needs and should ultimately prove useful to the Committee. The Chairman said that at present notes were recorded in the Kachcheri of the needs of the villagers of the district but in 10 cases out of 11 the suggestions were not practicable. In regard to irrigation schemes the Chairman said there were at present a fair number of minor irrigation schemes but that the Irrigation Sub-Inspector—the only one in the district—was engaged with special work and that if any more schemes had to be taken in hand it would mean a question of getting more men to work them. The resolution, slightly amended, was unanimously carried, reading :—

"That this District Agricultural Committee is of opinion that, in order to keep in close touch with the agricultural needs of the villages of the District, some form of Register of Village Agricultural Requirements be kept by the D. A. O., such register to be submitted regularly for consideration by the Committee."

4. *Appointment of a Sub-Committee to Report on the Present Situation, etc.* —Speaking on the second resolution in the name of Mr. Auchinleck, D.A.O., seconded by Mr. Garrick, he said this Committee was really a private body with no executive power. The Committee as at present constituted merely sat year in year out making suggestions and only doing a little work of practical value. He thought the various District Committees should have more power so that they might be able to induce Government to undertake works of utmost importance. It happened at times that one Assistant Government Agent favoured a scheme put forward by him, while another, having no interest in it, allowed it to die out. The Agricultural Department by itself could do little to advance its cause in the district except with the assistance and support of the District Committee. The force of a Committee was much greater in effect than that of one individual. Mr. Jardine, P.P.I., said that he was of the same opinion and as a case in point would refer to prosecutions in regard to removal of tea from infected areas. The penalty was so meagre that a culprit could break the law with impunity. The Committee should have power to press for heavier punishment, which was the only remedy in his opinion to stop the evil. The police generally prosecuted for theft rather than for the real crime. If a Sub-Committee were formed to draft a definite constitution with the possibility of it being authorized by Government it would be a distinct forward step. The Chairman said he thought heavier punishment could be asked for and would be obtained if the prosecuting officer explained the circumstances to the Magistrate. He said this from personal experience. The resolution was carried with the amendments suggested, and reads :—

"That this District Agricultural Committee appoint from its members a Sub Committee empowered to examine the following questions and to report thereon to the Committee :—

"(a) The present constitution, composition, scope and powers of the District Agricultural Committee of the Matale District.

"(b) The need for widening the composition, scope and powers of all these Committees so as to bring them into close touch with all aspects of agriculture in the district.

"(c) The advisability of drafting a definite constitution for these Committees, and the possibility of having such constitution duly authorised by Government".

The following gentlemen were appointed to serve on the Sub-Committee:—Mr. G. G. Auchinleck, D. A. O. (Chairman), Mr. Senior White, Mr. W. A. Udugama, Ratemahatmaya, South; and Mr. F. A Van Rooyen. It was decided to hold the meetings in Matale either at the Kachcheri or the Urban District Council Office, the Sub-Committee to forward their report in four months.

5. Results of paddy cultivation competitions and vegetable garden competitions 1923-24 were circulated for the information of Committee members.

6. Considered letter No. 2505 of 18th September, 1924, from Divisional Agricultural Officer submitting list of requirements, other than implements for School gardens in Matale, and asking that an annual vote be given for work of this kind in future.

(a) The Chairman said that there was no suggestion to build a girls' school at Pussela, but it was intended to acquire a piece of land to erect quarters for the teachers and then to make the school a mixed school, and that there was already a pipe to convey water to the school garden. The Divisional Agricultural Officer said he would go into the question of the pipe and report later.

(b) *Kuriwela.*—A wire fence was considered desirable.

(c) *Naula Well.*—It was thought that this was not absolutely necessary.

(d) *Pannampitiya Well.*—That this well would cost a large sum of money, and that there was no certainty of finding water.

(e) *Kaikawela.*—It was explained that the District School Committee proposed to carry out the suggestion of sinking a well. The following motion was unanimously carried, on the proposition of Mr. Auchinleck, D. A. O., seconded by Mr. Senior White:—

"That this Committee is of opinion that the Department of Agriculture should be given an annual vote for the provision of improvements to school gardens."

7. *Co-operative Societies.*—Considered letter No. 1624 of 1st October, 1924, from the Divisional Agricultural Officer showing position of Co-operative Societies in the Matale District on 30th April, 1924. The D. A. O, gave a brief account of the activities of the Societies, supporting it by figures indicating the interest aroused in the different divisions. He said that nine new societies were started since May, which was in itself encouraging, but he did not understand the apathy displayed by some of the Societies. The Societies in Matale South with all members of one caste seemed to work well while the same cannot be said of a division with members of different castes. He understood Ratemahatmaya, North, was starting two or three Societies shortly. The Nagolla Society was started 13 years ago and it was impossible to recover funds due to it. The Ratemahatmaya, South, said that the trouble in his division was that no high caste man would join a Society where people of a low caste were allowed as office-bearers.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For the Months of September and October, 1924.

TEA

The returns of green leaf were 4,102 lb. for the month of September and 4,497 lb. for the month of October, an increase of 1,102 lb. over the previous two months. The dadaps in plots 144 and 149 have been cut and mulched after an interval of three months, yielding 7,310 lb. and 1,530 lb. green mulch respectively. The *Gliricidia maculata* in

the ½ acre plot was lopped and yielded 7,140 lb. of mulch per acre equal to 42 lb. per tree. The dadaps in the ½ acre plot were lopped and yielded 3,570 lb. of mulch per acre equal to 21 lb. per tree. The Dark Leaf Manipuri Indigenous tea seed planted in nurseries in August have germinated well and the seedlings are making good growth. Couch and Cora grass which had become very troublesome in plots 147-149 and 155 have been dug out and destroyed. All drains and boundaries have been cleaned in readiness for the monsoon.

RUBBER.

Of the fifty plants of the large-seeded variety of rubber received from the Heneratgoda Gardens and planted in June, only 21 plants are alive.

The planting of *Centrosema pubescens* from cuttings in the New Avenue rubber has been continued. The portion planted previously from seed has grown well and the ground is completely covered. The plants have begun to flower and seed. Several orders for seed from the offspring of the Heneratgoda No. 2 tree have been supplied. The 3,000 seed from the Heneratgoda trees sown in nurseries have germinated well. The smoke-house has been improved ; a controlled opening has been made for ventilation at the ridge of the roof and the rest of the building made smoke-tight.

CACAO.

Two rounds of picking have taken place and a fair crop of good pods collected. Owing to the continued damp weather in August and September pod-disease is prevalent. Picking will be carried out every two weeks to check the spread of the fungus.

The third series of cacao fermenting experiments have been completed. The report on Series 1 and 2 has been received from Messrs. Cadbury Bros. Ltd., Birmingham, and will be tabled at the Meeting of the Estates Products Committee to be held on the 13th instant.

COFFEE.

The Hybrid bushes round the Show plots have been pruned.

In September all the plots were given a surface dressing of one basket of cattle manure per tree. Yields of coffees are recorded from October 1st to September 30th. The yields for the year ending 30th September, 1924, which are given below, include young trees that have come into bearing for the first time. Kalutara snails have been observed eating coffee blossoms and berries.

Variety.	Yield of berries per bush in lb.		
	1921-22	1922-23	1923-24
Robusta ...	1·83	3·99	2·37
Uganda ...	2·05	5·47	3·43
Quillou ...	2·31	4·98	6·91
Canephora ...	1·95	4·88	3·01
Hybrid ...	5·41	10·73	8·38
Arabian ...	—	1·00	2·39

The yields of the three Liberian varieties which are given below show a large increase over the previous year.

Variety.	Yield of berries per bush in lb.	
	1922-23	1923-24
Excelsa. ...	10·09	5·65
Abeocuta ...	3·78	9·16
Liberian Pasir Pogor	4·53	6·68

The growth of the Robusta and Liberian varieties is vigorous and healthy. The bushes are bearing a remarkably heavy crop.

COCONUTS.

Couch and Illuk have been pulled up again in the Bandaratenne area.

The palms were weeded round and coconut husk mulched round some of the palms to a distance of 5 ft. from the stem.

All drains have been cleared and cleaned.

FIBRE.

Sisal bulbils are being planted out in nurseries for supplying orders.

The ¼ acre plot of Roselle fibre (*Hibiscus sabdariffa* var. *altissima*) planted in the Annual Economic area in June is being cut down for extracting fibre. Accurate costs are being kept and a full statement of the cost of production will appear in the next report. Green caterpillars in large numbers were found destroying the leaves. Specimens have been sent to the Entomologist for identification and report. A trial plot of this fibre has been reserved for seed.

FODDER GRASSES.

The portion of land near the culvert at Bandaratenne under wild sun flower and Illuk was prepared and planted with Efwatakala-grass (*Melinis minutiflora*) which has grown luxuriantly in the Fruit plots.

Seed of the following new fodder-grasses have been received from the Department of Agriculture, Southern Rhodesia and sown in the Fruit plots :—

Buffel grass (Purple Top)
Rhodesian Tussock grass
Native Paspalum
Buffalo-grass
Coarse Guinea-grass

PADDY.

Half the area below the Economic Botanist's plots at Panchikawatte has been sown broadcast with Hatiel paddy at the rate of 1½ bushels per acre, and the other half transplanted 4, 6 and 9 inches apart with 1, 2 and 3 seedlings per hole respectively.

ECONOMIC COLLECTION.

Every other row in the Sisal and Mauritius Hemp plots has been uprooted as they were found to be too closely planted.

A plot of Camphor has been established. Plots 121-126 has been planted with Croton to serve as wind belts.

A plot of Stenophylla coffee has been added to the coffee section. Seed was obtained from the Director of Agriculture, Trinidad.

GREEN MANURES AND COVER PLANTS.

The following varieties, received from the Superintendent, Hope Gardens, Kingston, Jamaica, and the Chief of the Plant Breeding Station for Annual crops, Buitenzorg, Java, have been sown in the Show plots and in the vacant plots in the Annual Economic area.

Chlorophoro tinctoria
Desmodium gyroides
Crotalaria anagyroides.
Tephrosia Vogelii
Indigofera sumatrana

The green-manures and cover-plants planted under young rubber continue to make satisfactory growth.

BUNCHY-TOP IN PLANTAINS.

The experiment inaugurated in November last to test the treatment proposed by a plantain grower in Queensland who claimed success in the prevention of this disease showed 24 per cent. of plants affected with Bunchy Top in April, 1924. Since then no further cases have appeared. Suckers from the healthy plants will shortly be planted in the spaces between the present rows and the manurial treatment repeated.

GENERAL.

A plot of Hubam clover has been sown.

A new set of cooly lines (10 rooms) has been built by the Public Works Department. A further length of road opposite the Head Kangany's lines has been metalled and completed.

The station is still under quarantine, several fresh cases of hoof and mouth disease having broken out. One death has occurred amongst the cattle belonging to the staff.

The Revenue of the Experiment Station for the financial year ending 30th September, 1924, was Rs. 19,513·20 against Rs. 25,171·14 in the previous year. The decrease in revenue is largely due to the tea having been pruned during the year and the cacao crop being held up owing to the low prices ruling in the market.

RAINFALL.

	Inches	*Wet days.*
September	16·71	21
October	10·39	12.

H. A. DEUTROM,
Acting Manager,
Experiment Station, Peradeniya.

POULTRY.

HATCHING AND REARING CHICKENS.

(BY "POULTRY-KEEPER.")

The average poultry-keeper is always in too great a hurry about the raising of chickens, and is always in a fuss with the sitting hen. Once you decide upon the sort of poultry you mean to have, whether for egg production or the table, get your eggs from a recognised breeder, who not only has the class of birds that the poultry-keeper wants, but who also has a reputation for straight dealing.

And here it may be said that in buying, the purchaser should buy well up to his financial ability, for from the alleged "cheap" egg no satisfactory result can be obtained, and failing that satisfaction a whole season will be lost while waiting for the development of the chickens.

The class of birds to select from when seeking for higher egg production or better table quality, are generally found amongst the white Leghorns for eggs, Buff Orpington and Rocks for table, also the English Game. In choosing eggs for sitting discard the abnormal egg. Good quality eggs for hatching will be found in the one of normal size, of a smooth shell, free from corrugations and of a good oval shape, one not too long or slim or the reverse. As has been said, the egg should be "set" promptly for the earlier life of the egg contains the stronger germs, which will speedily respond to the quicker temperature. If a hen is to be employed for the incubating function, let there be no mistake about her ability and intention. For there is nothing under the sun more annoying, from a poultry-man's point of view, than for him to find himself landed with a setting of eggs, which has possibly cost a guinea or two, and in possession of a hen that has changed her mind.

A hen most suitable for patient sitting with eggs or for looking after the chickens when hatched, should be selected from such breeds as have in their veins a fair medium of Asiatic blood. For instance, the above-named hens carry out their duties well from first to last, *viz.*: The Buff Orpington, Wyandottes or, in fact, any breed of Orpingtons, Dorking Rock, etc., and also the English Game.

As there is a black sheep more or less in every flock, it will be as well when selecting a hen even from the breeds named, to test her with two or three china eggs, so as to see if she means to settle down. A hen of that breed, having taken to her nest, may be relied upon to fulfil her duty. The hen, besides being a good sitter, should be free from vermin, from scaly leg, and in robust health. These are the main features of a good sitter.

As a matter of health, this must be beyond doubt. So should the other essentials. I am for the back yarder; a strong upholder of the use of kerosene in keeping the insect pest in check.

This may be done by occasionally brushing kerosene over the roosts, etc. It is also of service if the hen is suffering from scaly leg. In such a

case as a broody hen being troubled with scaly leg use the kerosene or other remedies before the eggs intended for hatching are given to her. This is advisable for the sake of the eggs, which otherwise may be soiled, to their detriment. Moreover, it is important to clear the hen of the trouble before she takes to her proper nest.

A "scaly-legged" hen will invariably infect her chickens with this complaint. Prior to setting a hen a nest in a suitable place must be provided. Of all the places in a poultry establishment the poultry house is the worst place to carry on even the simplest form of incubation. In nature the hen will choose the most private place and one difficult of access. She demands quietness and freedom from any intrusion-features that are quite absent in a poultry house. Apart, too, from the desire, the nest and its contents are endangered by the presence, intrusions, and possible attacks from fowls, the result in such cases being broken eggs and the nest turned over. Having, therefore, been warned of the dangers of the proximity of poultry to the sitting hen the poultry-keeper will do his best to find a suitable place to fix up the nest. That having been done, the nest may now be arranged. Much will depend upon the season as to the suitable structure of a nest. Should the weather be wet and the ground damp and cold, the nest should be in a box or other receptacle with a dry floor. On the other hand, with the soil dry and warm, the nest may be on the ground, which should be well covered with straw or some other suitable material.

Whether the nest be on the ground or in a box, let the floor space be ample. It is a mistake to have a small, poky nest, restricting the movements of the hen. Therefore, let the nest place be large to give freedom. So that space may not in any way lead to the eggs rolling away from the hen and being neglected, see that the centre of the nest is to the west part of it, and the outlying part sloping inwards. Having the nest ready, and the hen in a proper frame of mind, let the hen have her liberty from the dummy eggs already in the nest. See that the hen has a supply of food and water. Let the water be supplied fresh every day. The hen, being now accustomed to her nest, and the eggs ready for hatching being marked, they will now take the place of the dummies.

The procedure should be well towards evening, so that the hen, eager for her nest and quietness, will enter without ado, and presently cover and shuffle the eggs to her satisfaction. It is advisable, when the hen is settled for the night, for the box or receptacle to be covered, and the hen kept in a darkened apartment for the first few days. With the hen well settled she may, after a while, be left free to go and come as she pleases, precaution being taken that she is supplied with proper food and water and a dust heap for her to roll herself in. As insect life breeds fast under the condition required for the incubation of chickens it may be taken for granted that the pests will not neglect their opportunity with the broody hen as their host.

Their presence is very objectionable to the hen, for they are making constant inroad into her flesh, extracting her blood and sapping her vitality. The dust heap is a capital means of reducing the insect pest, but it is not sufficient to entirely rid the hen of their presence and consequent annoyance. It is, therefore, necessary, absolutely necessary, both for the well-being of the hen and for the safety of the eggs that the nest is thoroughly renovated at least once a week.

This overhaul should be done when the hen is off her eggs for her food. The eggs then may be quickly removed to a secure place and the nest removed to a safe spot and the straw burnt. The box may then be well "smoked" or well treated with kerosene or other suitable insect destroyer,. When finished and fairly well dried, replace the box; if the day is hot a wet box will be objectionable. Sufficient soft straw or other material should then be used for the nest and the eggs carefully returned. While the eggs are out of the nest, should the day be cold, they should be kept well covered to keep their temperature right. The hen during the operation of the overhauling of the nest, may be impatient to resume her duties. A little extra food may help to keep her employed, but in no case allow her to return to the nest before the eggs have been properly placed in it. This insect pest question, in connection with the hen sitting on her eggs is important, and a great source of trouble. Should the pest get the upper-hand the hen will not only be likely to fail in her duty, but she will, in nine cases out of ten, leave the eggs, and that within a day or two of hatching. Now I have gone very fully over the ground of a "broody hen" and hatching chickens, so that all the poultry-keeper has to do is to carry out my instructions and have patience and the chickens will come out all right.—The South African Poultry Magazine and Small-Holder, VOL. XVIII, No. 153.

GREEN MAIZE AS FEED FOR POULTRY.

The risk of prussic acid poisoning, which is sometimes alleged to attend the use of green maize as feed for poultry, was a subject upon which a recent inquiry elicited the following statement from the Chemist, Mr. A. A. Ramsay :—

"So far as I am aware, the presence of a cyanogenetic glucoside in maize was not suspected prior to 1902. Investigations made since that date indicate that such a glucoside is present in small amounts, which increase up to the flowering stage, and decrease rapidly as soon as the cob begins to form, but the actual quantity does not become dangerous in ordinary circumstances.

"With regard to the feeding of green maize to poultry, I am of opinion that the likelihood of injury from hydrocyanic-acid poisoning is very small indeed, and is probably negligible. More especially will this be so if fed as part of a balanced ration, and in moderation, for the cyanogenetic glucosides are easily decomposed, and the action of hydrocyanic acid is inhibited by the presence of quite a number of substances – for example, sugar, cellulose meal, and even dry fibre. In this connection it should be noted that the Poultry Expert recommends in his book, *Poultry Farming in South Wales*, that green feed should be used merely as an adjunct, to be taken in small amounts and not in bulky quantities, as nature has not equipped poultry with the capacity for dealing with green feed in sufficient quantity to sustain life and to produce large numbers of such a concentrated product as an egg."

"I am of opinion," said Mr. J. Hadlington, Poultry Expert, "that the only trouble likely to arise from feeding green maize is from the fibre content in samples of advanced growth."—The Agricultural Gazette of New South Wales, Vol. XXXV, Part 10.

APICULTURE.

SOME CAUSES OF FAILURE OF BEGINNERS IN BEE-KEEPING.

Dr. ROCHA D'AMORIM, PORTUGAL*

The reasons that beginners in bee-keeping by the best modern methods become discouraged are many.

In face of observations gathered during the long time in which I have been a bee-keeper, of all others I consider the two most important points of failure to be the following : Insufficient knowledge or absolute ignorance of locality as the chief factor of all remunerative bee-keeping ; and inability to recognise robber bees.

The first brings discouragement because of the failure of a good harvest, which is the end to which all aspire, and the second by an abundant harvest of stings which is the plague which all fear.

On both subjects I here propose to say a few words; not with the intention of presenting any novelty, for I have discovered nothing new; but to call the especial attention of those interested to two most important practical topics to which, I incline to think, too little attention has been paid, and which result in grave loss to the industry, and to many of those who propose to take it up. Disappointments and vexations that many times force them to renounce their ambition.

All old bee-keepers agree that novices who enter the ranks have their heads well stuffed with theoretical knowledge. They know perfectly all that refers to the natural history of the bee, all her usual acts, and the moving episodes of her laborious and dramatic life, her customs, her bad inclinations and her instincts. They are not ignorant of any clever inventions of human intelligence, employed in getting the greatest benefit for themselves of the admirable qualities of work and economy of these wonderful insects. The best methods of guiding their bad instinctive tendencies are familiar to them, turning them as much as possible from their natural ways to make them our servants. They possess the most up-to-date hives and appliances, which permit them to practise rapidly and perfectly those modern methods which have been evolved during long years of observation and experiment. All this they know, and it seems that nothing is wanting; nevertheless in a short time they find they have to abandon the ranks of bee-keepers and put aside the undertaking which they began so hopefully, and which has but brought them disillusion and disappointment.

That which seemed to them the most promising prospect terminates rapidly in the most complete disaster. Why this failure, which was scarcely to be expected from their hot enthusiasm, from their erudition, and apparently technical proficiency ?

* Translated from the original MSS. in Portuguese by Mrs. G.B. Mitchell of Cintra, Portugal.

Because the science which is preached is not in reality so complete and so perfect as at first sight it seems to be. If we admit that it may be solid and profound, in respect to the life of the bees, it is not enough to ensure success in their culture, because it is one-sided and therefore incomplete.

They study minutely, and with the greatest care, all that refers to the agents which gather the harvest, and lamentably forget those which produce it.

First, everyone knows that to have honey, not only bees are wanted, but also flowers, which furnish the materials from which it is prepared; but, in practice, many never understand the fundamental importance which in the problem of production the native flora plays.

On this account they do not attempt to discover all the secrets of the flora, nor study them with the enthusiasm which they devote to the insects.

On this side the paucity of knowledge is pitiful and is the origin of many disasters, and of a great number of failures. This defect of leaving in the shade one of the sides of the problem is more pernicious and frequent than is generally believed.

Even the classic treatises on apiculture do not, for the most part, treat this question with the detail and emphasis which its importance demands.

It would be very convenient, if not only in them, but also in everything written for the furtherance of bee-keeping that the beginner should find this point explained in an explicit and impressive manner.

In the programme of teaching modern bee-keeping, the study of the flora and that of the bees should be as intimately joined as later they will be found to be when keeping bees.

Separate them, or relegate either of them to a secondary place, and the result will always be a defective preparation, from which nothing more is to be expected than a limited success, or even a miserable failure.

Striking examples of this assertion rise up on all sides and at every step which the badly prepared novice takes in practice.

He may know perfectly well how to transfer bees, either directly or by placing the hive to be emptied on the top of the new one, and either way he will get the worst results, if he does not do it at the beginning of the principal honey-flow. Not being acquainted, then, with the plants which produce honey, and the particularities of their growth, the times in which they flower, the rapidity or slowness with which they come into flower, and the duration of the flowering season, how then can the operation of transferring succeed? Sometimes this operation takes place long before the principal harvest, other times after it is terminated, so that at the very beginning of their practice of modern bee-keeping, the population of the hive, they come up against serious difficulties, which are hard to overcome, and when they are it is by recourse to artificial feeding, expensive, inconvenient and risky for the beginner. And as he continues, so difficulties continue until they reach the point where with the best will in the world the preparation of colonies for the good work of the harvest fails.

This will be totally or partially lost if at the beginning of the harvest the hives are not filled to over flowing with bees, but how can the beginner have his armies ready for the battle if he does not know beforehand when it will take place ?

Unhappily he, very often, does not even dream that the date of this memorable event, decisive in the life and prosperity of the colonies, and therefore also his allied interest, varies infinitely in different localities, from year to year, from season to season, as he also is ignorant that this disconcerting variability is in direct dependence on the conditions of the local flora, and not on the will or the activity of the bees.

The period of flowering of the plants from which the great secretion of nectar is to be expected may be continuous, short and early, continuous, short and late; intermittent and long, or continuous, long and weak.

As between the phases of the development of the colonies and the phases of the growth of the plants, there is a perfect accord, it is evident that each one of the floral moods pointed out ought to correspond with a special system in this management of the hives. And it is not alone the treatment to be given to the colonies which is dependent on this diversity of the local circumstances, but also the choice of the type of hive, and even the race of bees.

Thus in a locality where the harvest may be continuous, short and early, it may be necessary to stimulate to the utmost the laying of the queen, from the very first days when the bees are able to fly to their work.

In this case the reunion of colonies, and their strengthening "*a la Alexander*" is indicated, stimulative feeding hives with a brood nest not too large, and a very early-breeding race of bees, such for example, as the Carniolans.

Those who may have to count on a harvest, continuous, short and late, do not need to stimulate breeding, because the bees will have more than enough time for development before the nectar in its abundance appears in the supers. In this case it is not a question of doubling but of dividing colonies ; it will not be necessary to strengthen them by the before-mentioned processes; but on the contrary, to check, in order to avoid swarming, the excessive vitality of the strongest robbing from them frames of brood which should be distributed amongst the weakest, and finally the best bees in this case would be those which begin to breed a little later, for example, Italians,* and hives of great capacity.

If the harvest is intermittent and prolonged with two culminating points, one at the beginning of Spring, the other at the beginning of Summer, separated by a long space of decadence, in which the activity of the bees

* *Translator's Note.*—Here, in this district of Cintra, I find the Italians breed earlier and later than the native bees, that is, they continue to breed much later in autumn, and thus build up a better wintering condition.—G. B. M.

either is very little or is suspended; the methods indicated to be employed are those which permit of maintaining without weakening throughout the period of scarcity the high degree of efficiency to which the colonies attained during the spring flowering. The interregnum of forced rest will be an ideal opportunity for the breeding and substitution of queens. It is true that it may be necessary to resort to artificial feeding, but the stimulus which will be provided by this and the impatience of the young queens to lay will avoid the relaxation which would be fatal to the taking advantage of the nectar secretion of summer.

In this case the opportune providing of brood and the substitution of queens will stop by the temporary suspension of the queen's laying, the useless waste of the honey already stored in the spring, and assure to the colonies the vivacity and ardour of work at the necessary moment.

In the regions where the harvest is continuous, long and weak, the difficulty to be overcome is the exaggerated tendency to swarm.

This annoyance, which under other conditions might be almost unperceived, now assumes a capital importance. The solution of this difficulty, surrounded with difficulties and surprises, will put to the proof the competence and courage of the cleverest bee-man.

By the choice of a very large hive, of a race of bees less prolific, but more resistant or of longer life he may get some results.

But this is not enough, and he will have to resort to the constant and utmost vigilance to help in time with the manoeuvres and manipulations of the most varied description which to that end are counselled.

Certainly the production of honey in regions where this regime is the rule is laborious, and not always of a compensating abundance. On the other hand, the queen breeder will there find his paradise.

In face of all that has been set out and of much more that might be said, no one can deny the truth of this thesis which I set out to demonstrate.

Truly the want of knowledge of locality is an obstacle among the most difficult that the beginner can meet with during his career, and it is even one to many who consider themselves notable bee-keepers.

This curious race of theoretical bee-keepers may be pre-eminently able to keep bees by book, perhaps to treat bees in the moon, but they will completely fail within the limited ambit of their apiary, because the knowledge of realities is wanting, without which it is impossible for them to select among the diversity of methods in their arbitrary science that which best may be adjusted to the special circumstances of the part in which they have to work.

Perfect knowledge of locality is absolutely indispensable, and without it no one can make progress in bee culture.—The Bee World, Vol. V. No. 4.

GENERAL.

PRESENT-DAY PROBLEMS IN CROP PRODUCTION.*

SIR E. JOHN RUSSELL, F.R.S.

COMPLEXITY OF THE PROBLEM.

The agricultural investigator is confronted with three closely interlocking agencies—the plant, the climate, and the soil—each of which is variable within certain limits, and each playing a large part in the crop production which it is his business to study.

Confronted with a problem of this degree of complexity there are two methods of procedure: the empirical method of field observations and experiments, in which there is no pretence of great refinement and no expectation that the same result will ever be obtained twice, it being sufficient if over an average of numerous trials a result is obtained more often than would be exposed from the laws of chance ; and the scientific method, in which the factors are carefully analysed and their effects studied quantitatively; a synthesis is then attempted, and efforts are made to reconstruct the whole chain of processes and results. The scientific method is, of course, the one to which we are naturally attracted. But common truthfulness compels one to admit that up to the present the greatest advances in the actual production of crops have been effected by the empirical method, and not infrequently by men who are really artist rather than men of science, in that they are guided by some intuitive process which they cannot explain, and that they have the vision of the result before they obtain it, which the scientific man commonly has not.

The best hope for the future lies in the combination of the empirical and the scientific methods. This is steadily being accomplished by the recent strong infusion of science into the art of field experimentation, which has much enhanced the value of the field work and the trustworthiness of its results. Modern methods of replication such as have been worked out at Rothamsted, and in the United States by Harris of the Carnegie Trust (Cold Spring Harbor), Kiesselbach in Nebraska, Myers and Love of Cornell, and others, constitute a marked improvement in plot technique. The figures themselves, besides being more accurate, can be made to yield more information than was formerly the case.

Great advances have been made in the methods of analysing the results. The figures are never the same in any two seasons, since the climatic conditions profoundly affect the yields. A few men, like J. H. Gilbert, have the faculty of extracting a great deal of information from a vast table of figures, but in the main even the trained scientific worker can make very little of them. The reason is that he has been brought up to deal with

* From the presidential address delivered to Section M. (Agriculture) of the British Association, Toronto, August 11.

cases where only one factor is varying, while the growth of plants involves the interaction of three variable factors: the plant, the soil, and the climate. It is impossible to apply in the field the ordinary methods of the scientific investigator where single factors alone are studied; very different methods are needed, adapted to the case where several factors vary simultaneously.

Fortunately for agricultural science, statisticians have in recent years worked out methods of this kind, and these are being modified and developed by R. A. Fisher and Miss Mackenzie for application to the Rothamsted field data. It so happens that this material is very suitable for the purpose, since a large number of the field experiments have been repeated every year for seventy or eighty years on the same crop and on the same piece of land, using the same methods; the field workers also remain the same for many years, the changes being rare and without break in continuity. Although the statistical investigation is only recently begun, mathematical expression has already been given to the relationship between rainfall and yield of wheat and barley under different fertiliser treatments, and precision has been given to some of the ideas that have hitherto been only general impressions. If on an average of years a farmer is liable to a certain distribution of rainfall, it is becoming possible to advise as to fertiliser treatment which enables the plant to make the best of this rainfall.

ALTERATIONS IN THE PLANT.

It is a commonplace among farmers that certain soil conditions influence not only the yield but also the quality of crops. The leaf and root are more easily affected than the seed. The case of mangolds has been investigated at Rothamsted ; the sugar-content of the root, an important factor in determining feeding value, was increased by increasing the supply of potassium to the crop. Middleton at Cockle Park showed that grass increased in feeding value—quite apart from any increase in quantity —when treated with phosphates. Potatos are considerably influenced by manuring ; increasing the supply of potassium influences the composition of the tubers and also that much more impalpable quality—the cook's estimate of the value of the potato ; while we have found at Rothamsted that a high-class cook discriminated between potatos fertilised with sulphate of potash and those fertilised with muriate of potash, giving preference to the former.

Grain is more difficult to alter by changes in environmental conditions ; indeed, it appears that the plant tends to produce seed of substantially the same composition whatever its treatment—with the important exception of variation in moisture supply. Mr. Shutt has explored the possibilities of altering the character of the wheat grain by varying the soil conditions, and finds that increases in soil moisture decrease the nitrogen in the grain. Similar results have been obtained in the United States.

On the other hand, in England the reverse seems to hold, at any rate for barley. This crop is being fully investigated at the present time under the research scheme of the Institute of Brewing, because of its importance in the preparation of what is still Britain's national beverage. Increased moisture supply increases the percentage of nitrogen in the grain, and so also does increased nitrogen supply, though to a much less extent ; on the other hand, both potassic and phosphatic fertilisers may decrease the percentage of nitrogen, though they do not always do so ; the laws regulating their action are unknown to us.

The practical importance of these problems of regulating the composition of the plant lies in the fact that the farmer can control his fertiliser supply, and also to some extent his moisture supply, so that it lies within his power to effect some change should he wish to do so.

In agricultural science one sometimes thinks only of the crop and the factors that affect its growth. But in agricultural practice there is often another partner in the concern: a pest or parasite-causing disease. The amount of damage done by pests and diseases to agricultural crops is astounding; in Britain it is probably at least 10 per cent. of the total value of the crops and the loss is probably some 12,000,000*l.* sterling per annum; in some countries it is considerably more. Indeed, the number of insect pests and of harmful fungi and bacteria that skilled entomologists and mycologists have found in our fields might almost lead us to despair of ever raising a single crop, but fortunately the young plant, like the human child grows up in spite of the vast number of possible deaths. The saving fact seems to be that the pest does harm only when three sets of conditions happen to occur together; the pest must be present in the attacking state the plant must be in a sufficiently receptive state; and the conditions must be favourable to the development of the pest. It is because this favourable conjunction of conditions comes but rarely that crops manage to survive; and this gives us the key to control if only we knew how to use it. Complete control of any of these three conditions would end all plant diseases. Unfortunately, control is never complete even in glass-house culture, still less out of doors. But even partial control would be very helpful. All these pests go through life cycles, which are being studied in great detail all over the world, and especially in the United States. Somewhere there occurs a stage which is weaker or more easily controlled than others, and the pest would become harmless if the chain could be broken here or if the cycle could be sufficiently retarded to give the plant a chance of passing the susceptible stage before it is attacked.

The plants themselves, as we have just seen, are in some degree under control, and if they could be pushed through the susceptible stages before the pest was ready, they would escape attack. Barley in England is sometimes considerably injured by the gout fly (*Chlorops taeniopus*). The larvæ emerge in spring from the eggs laid on the leaves and invariably crawl downwards, entering the young ear if, as usually happens, it still remains ensheathed in leaves. J. G. H. Frew, at Rothamsted, has shown that early sowing and suitable manuring cause the ear to grow quickly above the track of the larvæ. and thus to escape injury. E. A. Andrews, in India, has found that tea-bushes well supplied with potassic fertiliser escape attack from the mosquito bug (Helopeltis) for the rest of the season, apparently because bushes so treated become unsuitable as food to the pest. Further, the conditions are alterable. H. H. King, in the Sudan, has effected some degree of control of the cotton thrips (*Heliothrips indicus*) by giving the plant protection against the drying north wind and so maintaining a rather more humid atmosphere—a condition in which the plant flourishes more than the pest. Tomatos in England suffered greatly from Verticillium wilt until it was found that a small alteration of temperature threw the attack out of joint. They are also much affected by stripe disease

(*B. Lathyri*), but they become more resistant when the supply of potash is increased relative to the nitrogen. It has recently been maintained, though the proof is not yet sufficient, that an altered method of cultivating wheat in England will afford a good protection against bunt. These cultural methods of dealing with plant diseases and pests offer great possibilities, and a close study jointly by plant physiologists and pathologists of the responses of the plant to its surroundings, and the relationship between the physiological conditions of the plant and the attack of its various parasites, would undoubtedly yield results of great value for the control of plant diseases. Again, however, the plant breeder can save a world of trouble by producing a variety resistant to the disease; or there may fortunately be found an immune plant from which stocks can be had, as in the case of the potatos found by Mr. Gough to be immune to the terrible wart disease.

CONTROL OF ENVIRONMENTAL FACTORS.

It thus appears that, if only plant breeders and plant physiologists could learn to alter existing plants or to build up new plants in such a way that they should be well adapted to existing soil and climatic conditions, and not adapted to receive disease organisms at the time the organisms are ready to come—if only they could do this, all agricultural land would become fertile and plant diseases and pests would become ineffective: at any rate until the pests adapted themselves to the new plants. Although no one can set limits to the possibilities of plant breeding and plant physiology, we cannot assume that we are anywhere near this desirable achievement or that we are likely to be in our time.

There will always remain the necessity for altering the environmental conditions to bring them closer to the optimum conditions for the growth of the plant. No attempt is yet made in the field to control two of the most important of the factors: the light and the temperature, though it is being tried experimentally. There is a great field for future workers here; at present plants utilise only a fraction of the radiant energy they receive. At Rothamsted attempts have been made by F. G. Gregory to measure this fraction; the difficulties are considerable, but the evidence shows that our most efficient plants lag far behind our worst motor-cars when regarded as energy transformers for human purposes. One hundred years ago the efficiency of an engine as a transformer of energy was about 2 per cent.; now, as a result of scientific developments, it is more than 30 per cent. To-day the efficiency of the best field crops in England as transformers of the sun's energy is about 1 per cent.: * can we hope for a similar development in the next hundred years? If such an increase could be obtained an ordinary crop of wheat would be about 400 bushels per acre and farmers would feel sorry for themselves if they obtained only 200 bushels. But we are only at the beginning of the subject. Increases in plant growth amounting to some 20 or 25 per cent. have been obtained by V. H. Blackman in England under the influence of the high-tension electric discharge, which presumably acts by increasing in some way the

* The remaining energy being largely used-up in transpiration, this figure refers to the total radiation received by the leaf, and not to the fraction received by the chloroplast surface. For this latter the value is much higher.

efficiency of the plant as an energy transformer. Possibly other ways could be found. It needs only a small change in efficiency to produce a large increase in yield. Much could be learned from a study of the mass of data which could be accumulated if agricultural investigators would express their results in energy units as well as in crop yields as at present.

Interesting results may be expected from the attempts now being made in glass-house culture both in Germany and at Chestnut to increase the rate of plant growth by increasing the concentration of the carbon dioxide in the atmosphere.

CONTROL OF THE SOIL FACTORS.

The soil factors lend themselves more readily to control and much has been already achieved. Water supply was one of the first to be dealt with. Civilisation arose in the dry regions of the earth, and so far back as 5,000 years ago, irrigation was so advanced as a practical method that it came into the ordinances drawn up by the great Babylonian king Hammurabi. The chief problems at the present time are to discover effective means of economising water and to ascertain, and if possible control, the relationships between the soil, the water, and the dissolved substances in the water.

Inseparably bound up with water supply are the questions of cultivation and of drainage, which affect not only the water but the air supply to the roots. The former subject is now attracting considerable attention: the great need is to discover means for expressing cultivation in exact physical and engineering units. The measurements of Keen and Haines at Rothamsted, and the chemical work of A. F. Joseph, N. Comber, and others on clay, and of Oden, Page, and others on humus, indicate the possibility of finding exact expressions and of effecting co-operation with the workers in the new fields of agricultural engineering.

Another soil factor which readily lends itself to some degree of control is the amount of plant nutrients present. The possibility of increasing this by means of manure has been so frequently explored in field trials that it has sometimes been regarded as almost a completed story; indeed, Rothamsted tradition affirms that Lawes himself once gave orders to have the Broadbalk field experiments discontinued because they had nothing further to tell; it was only the earnest pursuasion of Gilbert that caused him to countermand the order. So far from the subject being exhausted it still bristles with problems. The new nitrogenous fertilisers, resulting from War-time activities in nitrogen fixation; the need for reducing the cost of superphosphate; the change in character of basic slag; and the Alsatian development in potash production, are producing changes in the fertiliser industry the full effects of which are not easy to foresee. Economic pressure is driving the farmer to derive the maximum benefit from his expenditure on fertilisers, lime, farmyard manure, and other ameliorating agents, and is compelling a more careful study of possibilities hitherto disregarded, such as the use of magnesium salts, silicates, and sulphur as fertilisers, and, above all, a much more precise diagnosis of soil deficiencies than was thought necessary in pre-War days.

There are, however, more fundamental problems awaiting solution. It is by no means certain that we know even yet all the plant nutrients. The list compiled by Sachs many years ago includes all needed in relatively large amounts, but Gabriel Bertrand has shown that it is not complete and that certain substances—he studied especially managnese—are essential, although only in very small amounts. Miss Katherine Warington working with Dr. Brenchley at Rothamsted, has shown that leguminous plants fail to develop in the so-called complete culture solution unless a trace of boric acid is added. Mazë has indicated other elements needed in small amounts.

Another problem needing elucidation is the relationship between the quantiny of nutrients supplied and the amount of dry matter produced. Is dry matter production simply proportional to nutrient supply as Liebig argued, with the tailing off beyond a certain point, as demonstrated by Lawes and Gilbert, or is it always less than this as indicated by Mitscherlich's logarithmic curve; or is the relationship expressed by one of the more complex sigmoid curves as there is some reason to suppose? We do not know: and the problem is by no means simple, yet it governs the "diminishing returns" about which farmers now hear so much.

Again, very little is known of the relationship between nutrition and the period of growth of a plant. One and the same quantity of a nitrogenous fertiliser, for example, may have very different effects on the plant according as it is given early or late in life; not only is there a difference in quantity of growth, but also in the character of the growth. Late dressings cause the characteristic dark-green colour to appear late in the season, and thus affect the liability to fungoid diseases; they increase the percentage of nitrogen in the grain and they may give larger increases of crop than early dressings.

Investigations are needed to find the best methods of increasing the supply of organic matter in the soil and its value for the different crops in the rotation.

All these problems will sooner or later find some solution. But there remains a greater problem of more importance than any of them: the linking-up of plant nutrition studies with those of the soil solution. As our cousins in the United States were the first to emphasise, the fundamental agent in the nutrition of the plant is the soil solution, and they have made a remarkable series of investigations into what appeared at one time a hopeless proposition—the physico-chemical interactions between the soil and the soil water. A great advance in crop production may be expected when the soil chemists have discovered the laws governing the solution, when the plant physiologists can give definite expression to the plant's response to nutrients, and when some one is able to put these results together and show how to alter the soil solution so that it may produce the maximum effect on the plant at the particular time. The new soil chemistry will yet have its triumphs.

THE SOIL MICRO-ORGANISMS.

It is now more than forty years since the discovery of the great importance of micro-organisms in determining soil fertility. Practical applications necessarily lag far behind; but already three have been made each of which opens out great possibilities for the future. The long-standing problem of inoculation of leguminous crops with their appropriate

organisms has already been solved in one or two of its simple cases, chiefly lucerne on new land, and the new process has helped in the remarkable extension of the lucerne crop in the United States and in Denmark. We believe at Rothamsted that the more difficult English problem is now solved also. Interesting possibilities are opened up by the observation that a preliminary crop of Bokhara clover seems to facilitate the growth of the lucerne.

The organisms effecting decomposition are now coming under control and are being made to convert straw into farmyard manure (or a material very much like it) without the use of a single farm animal. The process was worked out at Rothamsted, and is being developed by the Adco Syndicate, which is now operating it on a large scale and is already converting some thousands of tons of straw annually into good manure.

The third direction in which control of the soil organisms is being attempted is by partial sterilisation. This process is much used in the glass-house industry in England, and it has led to considerable increases in crop yields. The older method was to use heat as the partial sterilising agent, and this still remains the most effective, but owing to its costliness efforts have been made to replace it by chemicals. Considerable success has been attained; we have now found a number of substances which seem promising. Some of these are by-products of coal industries; others, such as chlor-and nitro-derivatives of benzene or cresol, are producible as crude intermediates in the dye industry.

THE NEED FOR FULLER CO-OPERATION.

Looking back over the list of problems it will be seen that they are all too complex to be completely solved by any single worker. Problems of crop production need the co-operation of agriculturists, plant physiologists, soil investigators, and statisticians. Even plant breeding necessitates the help of a physiologist who can specify just what the breeder should aim at producing. This gives the keynote to the period of agricultural science on which we have now entered—it is becoming more and more a period of co-operation between men viewing the problem from different points of view. Good individual work will of course always continue to be done, but the future will undoubtedly see a great expansion of team work such as we know from our experience at Rothamsted is capable of giving admirable results in agricultural science.

With fuller co-operation both of men and of institutions we could do much to overcome the present difficulty in regard to utilising the information we already possess. In the last thirty years an immense stock of knowledge has been obtained as to soils and crops. It is stored in great numbers of volumes which line the shelves of our libraries, and there much of it rests undisturbed in dignified oblivion. In the main it consists of single threads followed out more or less carefully; only rarely does some more gifted worker show something of the great pattern which the threads compose. But even the most gifted can see but littte of the design; the best hope of seeing more is to induce people to work in groups of two or three, each trained in a different school and therefore looking at the problem from a different point; each seeing something hidden from the rest. Unlike art, science lends itself to this kind of team work; art is purely an

individual interpretation of Nature while science aims at a faithful description of Nature, all humanistic interpretation being eliminated. There is certainly sufficient goodwill among the leaders of agricultural science to justify the hope of co-operation; there are probably in existence foundations which would furnish the financial aid.

This leads to my last point. What is the purpose of it all? Team work, co-operation, the great expenditure of time and money now being incurred in agricultural science and experiment—these are justified only if the end is worthy of the effort. The nineteenth century took the view that agricultural science was justified only in so far as it was useful. That view we now believe to be too narrow. The practical purpose is of course essential; the station must help the farmer in his daily difficulties—which again necessitates co-operation, this time between the practical grower and the scientific worker. But history has shown that institutions and investigators that tie themselves down to purely practical problems do not get very far; all experience proves that the safest way of making advances, even for purely practical purposes, is to leave the investigator unfettered. Our declared aim at Rothamsted is "to discover the principles underlying the great facts of agriculture and to put the knowledge thus gained into a form in which it can be used by teachers, experts, and farmers for the upraising of country life and the improvement of the standard of farming."

This wider purpose gives the investigator full latitude, and it justifies an investigation whether the results will be immediately useful or not—so long as they are trustworthy. For the upraising of country life necessitates a higher standard of education for the countryman; and education based on the wonderful book of Nature which lies open for all to read if they but could. How many farmers know anything about the remarkable structure of the soil they till, of its fascinating history, of the teeming population of living organisms that dwell in its dark recess; of the wonderful wheel of life in which the plant takes up simple substances and in some mysterious way fashions them into foods for men and animals and packs them with energy drawn out of the sunlight—energy which enables us to move and work, to drive engines, motorcars, and all the other complex agencies of modern civilisation? No one knows much of these things; but if we knew more, and could tell it as it deserves to be told, we should have a story that would make the wildest romance of human imagination seem dull by comparison and would dispel for ever the illusion that the country is a dull place to live in. Agricultural science must be judged not only by its material achievements, but also by its success in revealing to the countryman something of the wonder and the mystery of the great open spaces in which he dwells.—Nature, Vol. 114, No. 2864.

THE PRESENT STATUS OF PORTO RICAN VANILLA.

T. B. Mc CLELLAND.

Some years ago vanilla cuttings were imported by this Station from the Subtropical Garden at Miami, Florida, where a large collection of varieties had been assembled. In this collection were a few cuttings of Vanilla planifolia of Mexican stock, the kind from which the finest beans are obtained. This very small beginning was carefully tended and gradually the supply of vanilla vines was increased, a slow process since propagation must be made by planting sections of vine.

At perhaps an earlier date than the station importation, cuttings were imported from Mexico also by some relative of Don Miguel Morell of Utuado and these were propagated in a small non-commercial way for many years by that family. So far as is known by the writer these two importations represent the source of the Vanilla planifolia as found in Porto to-day.

In the course of a few years a proportionally large production of beans was had from station plantings and the prospects for the commercial production of vanilla beans in Porto Rico looked very bright. Recommendation was made to the planters that vanilla growing be tried and many planters were supplied with cuttings, usually in a small way for the stock was limited.

In most instances these cuttings were tended for a while and then abandoned through lack of further interest, the vines being left either to clamber at will as plants returned to the wild, or left to be uprooted by pigs and chickens. In many places scattered here and there over the island there are to be found the remnants of these distributions.

Only two or three planters out of the numbers who were supplied with cuttings continued to the point of producing a marketable crop.

One of these planters, Mr. S. W. Marvin, sold this year 1,375 pounds of cured beans at $10 a pound. Mr. Marvin estimated this production to be from the equivalent of approximately six acres. It was actually from scattered plants in two acres set in 1918 and now much depleted in number through disease, and from five additional acres set in 1920. Mr. Marvin is extending his plantings and has at present 22 acres set to vanilla and expects to plant 10 acres annually for the next few years. His success as pioneer vanilla planter has been noteworthy.

While Mr. Marvin's plantation is the largest on the island, there are several others much less extensive. Mari Hermanos of San Germàn have sold some beans from their plantings which are on two widely separated plantations, and the writer has been informed that Mr. Serra of Ponce has recently set a number of acres to vanilla.

The present high price of vanilla has greatly stimulated interest in planting it. When the station first recommended planting this crop beans from Porto Rico had sold at $2·50 and $3·00 a pound. Now that this figure is trebled or quadrupled interest has increased proportionally. The present price is due to the shortage in the crop and increased consumption. It will no doubt stimulate new plantings in all vanilla growing regions and by the time these new plantings come into production the price will probably be much lower than at present owing to the increased supply Those who plant at present should not figure on getting $10 a pound for their vanilla beans.

The history of plantings in Porto Rico has shown that after several crops have been obtained the vines succumb to a root disease which we are at present unable to combat successfully. The vine may not even reach maturity or on the other hand it may produce as many as seven crops before it succumbs.

Whoever plants vanilla must consider it a temporary crop because of this root disease, and the planter should consider what is to be done with his land after the vanilla has been killed off.

Coffee and vanilla appear admirably adapted as a crop rotation. There are many coffee plantations with areas of good soil only sparsely set with old coffee trees. These areas might well be cleared of their large old shade trees and set to small leguminous shade trees, such as the dwarf bucare (*Erythrina corallodendron*), suitable for supporting the vanilla vines, and easily propagated by cuttings. It is a matter of common experience that the removal of shade from coffee is usually followed by a temporary increase in crop. The old coffee trees may be left for a while to produce what they will. As soon as the bucare cuttings have developed sufficiently to carry the vanilla vines, the vanilla cuttings may be placed on them. Certainly by the time the vanilla comes into blossom the rows should be interplanted with young coffee trees. Eight feet apart each way or 6 or 7 feet by 9 feet should prove satisfactory spacing distances for both the vanilla vines and the coffee. By the time the vanilla would probably succumb to disease the coffee should be in production. At only a limited additional expense over and above the cost of caring for the vanilla, the land would be with a productive crop rather than merely shaded by a tree little esteemed for the quality of its wood.

This rotation should leave the coffee plantation in better condition after the vanilla planting than before, since instead of old scattered coffee trees under old high shade the field would be uniformly set with young trees and young low shade. If forest sweepings or humus forming materials have been applied to the vanilla vines, a procedure to be recommended, the land would be benefitted and in better condition for the coffee which is to follow the vanilla.

Almost any agricultural proposition is a gamble and vanilla is no exception. It is particularly liable to disease but under favourable conditions and with a reasonable amount of attention the chances are good for the planter to make a handsome return on his investment before the vines succumb.

The first crop of any importance should be ready for market in the fourth year and normally an annual increase may be expected for several years provided disease does not get too early and too great a start.

The pollination must be effected by hand. This comes in the spring. It is easy work and may be done by women and children as well as men. The harvest of the beans extends through several months but is heaviest after the main coffee crop has been collected so that the handling of the two crops does not greatly overlap.

The curing process is simple but requires much time and attention. The beans are alternately sunned and sweated until the proper stage of softness has been attained. They are then placed on open shelves and left exposed to the air until the original weight has been reduced in a ratio of 4 or 4-½ to 1. This means going over the crop bean by bean at frequent intervals during the curing process. On completion of the curing the beans are packed into tin containers lined with oiled or waxed paper and shipped to buyers of vanilla on the continent, of whom there are a number.

If the curing has been properly done and the containers are air-tight the beans may be held for long periods if desirable without deterioration.

Owing to the ravages of the root disease this Station is unable to distribute vanilla cuttings at present.

If any who have cuttings for sale will notify this Station their names will be kept on file and will be furnished to any who may inquire where cuttings are to be purchased.—Agricultural Notes, Published by Porto Rico Agricultural Experiment Station.

FURFURAL.

PROFESSOR F. HARDY, M.A.

[Furfural is a plant product of coming importance and its local manufacture may prove to be the means of more profitably utilising waste material in many branches of tropical agriculture.]

The onward march of biochemical technology adds almost monthly to our list of commercially useful substances. One of the most promising of recent additions to this list is furfural, which, as the name implies, was first prepared from bran. Furfural is a colourless liquid, boiling at 162°C. It finds its chief employment as a solvent and germicide. Chemically, furfural is an aldehyde, resembling in this respect formaldehyde, whose aqueous solution (formalin), is one of the chief industrial antiseptics at present in use. Furfural, however, bids fair to rival formaldehyde, since recently it has been found possible to manufacture it on a large scale and at low cost from waste vegetable matter. Whereas in 1920, the price quoted for furfural was 30 dollars per lb., the substance is now being sold at 25 cents per lb. This remarkable drop in price is due entirely to the co-operation between research workers and manufacturers of plant products.

The story of furfural is clearly told in a series of publications. The main contribution to the development of the commercial manufacture of furfural has come from the United States Bureau of Chemistry. Earlier workers in the field of cellulose chemistry had demonstrated that corncobs, when treated with hot water under pressure, yield a valuable adhesive, together with varying amounts of furfural. Further experiments, planned with the definite idea of increasing the yield of furfural, indicated that the process might be developed into a paying commercial industry. This conclusion was amply confirmed by large scale trials by which it was shown that a plant capable of handling 50 tons of corncobs per day could produce therefrom 9,000 lb. of furfural, at an estimated cost of 6·15 cents per lb. The success of such a venture depends, of course, on a regular supply of raw material of low price. This is realised in the great corn belt of the United States, and in certain other corn growing regions, such as the valleys of the Mississippi River Basin, where waste corncobs can be obtained at 2 to 3 dollars per ton.

Corn cobs are not the only fruitful source of furfural. Indeed, almost any vegetable matter that contains the gummy substances known as pentosans, on treatment with boiling water or steam, especially at high pressure and in the presence of a trace of acid, gives furfural. The chemical change that proceeds is known as hydrolysis ; pentose sugars are formed as intermediate products. Among the many waste vegetable materials that contain pentosans, may be mentioned the following tropical examples ;— corn stalks, banana stalks, cotton seed hulls, sugar-cane megass, kapok waste, and saw dust. These contain different amounts of pentosan, however, and are not equally valuable as sources of furfural. Thus, Farnell found that sugar-cane megass may contain as much as 25 to 31 per cent. of pentosan, which agrees with the earlier results of C. A. Browne and of Geerligs. Pervier and Gortner found 15 per cent. of pentosan in a sample of pine sawdust, and Ritter and Fleck found percentages varying

from 6 to 23 in the wood of various North American trees. These figures should be compared with the pentosan content of corn cob, which is usually about 35 per cent. The investigation of the pentosan contents of other vegetable wastes awaits further attention.

The industrial uses of furfural are numerous and varied. Recently, there has been an active interest taken in the preparation of tarry resins from furfural by treatment with alkali, and of hard resins by combination with phenols. These latter derivatives find great use in the manufacture of gramophone records, which formerly were made almost exclusively from phenol-formaldehyde compounds. As a fungicide and insect repellant, furfural can be used in place of formaldehyde. As a solvent of varnishes and cellulose esters, it has great possibilities. At least two valuable dyestuffs can be obtained from it, and a new anæsthetic derived from furfural is being carefully tested. In the rubber factory, furfural may be used as an accelerator in vulcanization, and on the rubber estate as a bactericide for preserving latex. Finally, furfural burns slowly with a luminous flame, and finds use as a fuel for certain purposes. According to La Forge, a market for several million pounds of furfural per year is doubtless forthcoming in the near future.

In addition to furfural, the simultaneous production of pentosan adhesive and of valuable cellulosic material which finds use in paper manufacture, as well as of certain organic acids renders the preparation of furfural from vegetable waste a highly practical and economical process. It is to be hoped that tropical chemical technologists will take note of the possibilities of this promising new industry.—Tropical Agriculture, Vol. ,I No. 10.

THE CONTRIBUTION OF DYING LEAVES TO THE PLANT.

Whoever studies the processes which go on in plants is impressed with the economy which the parts exercise in the interests of the whole. As is well known, the leaves of green plants are the factories in which are manufactured the food-materials which serve to nourish all living plants. Day by day in sunshine the leaves produce from the raw materials which they receive from soil and air the sugars and nitrogenous substances which supply to the cells of plants, no less than the cells of animals, the materials for growth, multiplication, activity and repair. Each morning the task of distribution of sugars carried on incessantly throughout the night finds itself as near as may be completed. And hence it is that a leaf gathered in the early hours of the morning contains less dry matter than one of equal size contains at evening time after the day's manufacturing work is done.

What is true of the relatively simple sugars is also true of the more complex nitrogen-containing food materials. They are manufactured from elementary substances during the day and distributed to all the young parts of the plant continuously. And so the work of the plant never ceases throughout day and night. Then there comes a time when in this

climate of alternating seasons the leaves begin to lose activity, wither, turn yellow or brown, and presently fall. As they lose their summer vigour the manufacturing activity of the leaf, which is bound up with the presence of green colouring matters in its cells, declines and before the leaf falls it is a dried and dead thing no longer making daily contribution to the sustenance of the plant.

Yet, as recent investigations* have demonstrated, before a tree parts with a leaf it yields to the plant which bears it much of the residual food material which it made and stored before autumnal old age brought the leaf's activities to a standstill. Of the sugar-like materials contained in the leaf just beginning to turn yellow only about a quarter migrates into the stems and roots ; half of the total carbohydrate contents of the just withering leaf remain in it and go to enrich the soil with humus when the leaf falls and decays ; the remaining quarter is consumed—burned up to supply the declining energies of the dying leaf. Sugars and similar carbohydrates are lightly come by in the green plant, and "lightly come, lightly go." The loss of the small quantity which falls with the dying leaf is of small moment to the plant.

It is otherwise, however, with the nitrogenous food-materials manufactured by the leaf. Nitrogen in a form which the green plant can use is scarce in nature and the green plant is as niggardly, in its use of nitrogen as it is extravagant in its use of sugars and carbohydrates. Mr. Combes has shown, for example, that in the case of Sycamore and Chestnut no less than half of the total quantity of nitrogenous materials contained in the leaf is handed back by it as a dying legacy to the stem and root. In the Beech, Horse Chestnut, and Spanish Chestnut the removal of residual nitrogenous materials from the leaf about to fall is even more complete, and often no more than one-third of the quantity present when the leaf-began to assume its autumnal state remains in the withered and fallen leaf.

So little do we know of the essential details of plant life that it cannot yet be said why the leaf of any of our deciduous trees is made to die with the onset of winter. Its richness in carbohydrate shows that it does not die of starvation. The final act in the recurrent drama of the fall of the leaf may be ushered in by the formation of a "cutting-off" layer of cork which arises in the petiole and checks the ascent of water to it. But the first act is unknown. What causes the leaf, erstwhile in full vigour and activity, to begin with the year to wane and what leads to its self amputation still escape the knowledge of plant physiologists. The phenomena is so common that it does not excite wonder, yet every falling leaf carries with it to its grave on the ground, a mystery which those who delight in discovering nature's ways would give much to penetrate.

Needless to say the material contained in the fallen leaves is not wholly lost to the plant. As the leaves decay much of their substance is converted again into the simple compounds from which that substance was manufactured ; but some leaves decay only partially and give rise to humus from which fungi and non-green plants derive sustenance and from which also the tree from which the leaves fell does not disdain to draw

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* *Migration des substances azotees pendant le jaunissement des feuilles des arbres.* By R. Combes. Bulletin de la Societie Botanique de France. Vol. 71 (4th Series, Vol. 24), 1924

upon for its further nutriment. Knowing this the gardener takes care to collect all available fallen leaves and to compost them, for in these days of shortage of stable manure, leaf-mould—always precious to the cultivator—has become of very great value in the garden. It is a mistaken practice to burn the waste vegetable debris of the garden. All of it, if properly composted, helps to maintain the fertility of the soil ; entering once again into the bodies of new generations of plants it continues the endless migration from the inorganic to the organic world and back again to the inorganic world.—Gardeners' Chronicle, Vol. LXXVI. No. 1966.

MADAGASCAR SANDAL.

H. PERRIER DE LA BATHIE.

(*Translated from the French by H. L. Ludowyk, Librarian, Department of Agriculture, Peradeniya.*)

Madagascar exports every year, almost solely to British India, a quantity of sandal (286 tons in 1921, 100 in 1922) which the Hindoos use, it wood seem, especially in religious observances. This sandal has the peculiarity that it is not furnished, as are other fragrant woods of this name, by species of the genus *Santalum*, but by a Rubiaceous plant confined to the island of Madagascar, *Santalina madagascariensis* Baillon.

The exported product is obtained from the roots or old stems of this plant, which is a shrub of 3 to 4 metres high with evergreen leaves and the aspect of the Myrtle or the Olive tree. It grows especially in rocky and dry places, on banks of torrents, and, sometimes, also on bare sand, in all the western region, from the North to the extreme South. It never forms large forests and, like the large majority of the plants of Madagascar, occurs rather as isolated examples, often very distant from one another. The young wood has scarcely any odour, and it is the oldest stems that are chiefly sought out and utilised for export.

As in the case of all the other forest products of Madagascar, the export of this sandal cannot be said to be developing, but rather to be diminishing rapidly, and will soon disappear. This species, which grows in a region ravaged by bush fires, is, indeed, threatened with total extinction not only owing to its exploitation, but also as a result of the general destruction of all the woods on this part of the island. Besides, the Colony has no interest in restraining this exploitation for it is better that the existing sandal should be exported rather than burnt wastefully on the spot. In order to preserve the sandal, like the ebony and the other valuable species of this region, it is necessary to establish, forthwith, reserves where this species might be preserved and multiplied. Without the establishment of such reserves, all other protective measures are illusory.

Madagascar sandal is exported chiefly from the ports of Morondava and Majunga. The natives call the wood Masinjana or Masanjana. They use it for different purposes. Mixed with Temo—tamo (root of *Curcuma*) and applied as a face powder, Masinjana is largely used as a medicine or for religious ends (tromba). This same powder mixed with physic-nut oil and Raraha (*Bochoneura*) resin or with Ramy (*Canarium*) is the favourite perfume of the fashionable ladies of the East and the South.—Revue de Botanique appliquee, IV,. pp. 531—532.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 10th NOVEMBER, 1924.)

NAME OF PRODUCE		CURRENT PRICE Rs. cts.	at	Rs. cts.	REMARKS
CACAO—(At Buyer's Stores)					
Estate—Finest	per cwt.	60 00	,,	64 00	
Do Medium	do	35 00	,,	48 00	
Do Common (Black)	do	10 00	,,	20 00	
CARDAMOMS					
All round parcel well bleached	per lb.	... ...	,,	... ...	
Do do medium	do	2 70	,,	3 25	
Special assortment 0 & 1 only	do	... ...	,,	... ...	
Seeds	do	... ...	,,	... ...	
Green	do	3 15	,,	3 25	
CINNAMON QUILLS—(At Buyer's Stores)					
Ordinary assortment (in bales of 100 lb. nett)	per lb.	0 90	,,	0 95	
No. 1	do	0 92	,,	0 97	
No. 2	do	0 90	,,	0 95	
No. 3	do	0 86	,,	0 91	
No. 4	do	0 83	,,	0 88	
CINNAMON CHIPS—Maradana, (At Buyer's Stores) (in bags of 56 lb. nett) per candy of 560 lb.		85 00	,,	95 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	1 85	,,	1 9	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores) ... ... Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 20½	,,	0 21	
COCONUT OIL—					
White Oil f.o.b	per ton	... ...	,,	630 00	
Ordinary Oil do	do	... ...	,,	600 00	
COPRA—					
Calpentyn	No. 1 quality per candy of 560 lb.	81 50	,,	87 50	
Estate	,, ,,				
Ordinary quality (Maravila)	,, ,,				
Cart Do do	,, ,,				
FIBRES—(At Buyer's Stores)					
Coconut Bristle No. 1	per cwt.	9 75	,,	11 00	
Do No. 2	do				
Coconut Mattress No. 1	do	3 00	,,	3 25	
Do No. 2	do				
Coir yarn, Kogalla Nos. 4 to 9	do	12 00	,,	25 00	
Do Colombo Nos. 3 to 7	do				

PLUMBAGO		X. B. Rs. cts.		Rs. cts.	B Rs. cts.		Rs. cts.	B. E. Rs. cts.		Rs. cts.
Ordinary Lumps	per ton	275 00	at	325 00	200 00	at	275 00	175 00	at	200 00
Chips	do	180 00	,,	275 00	150 00	,,	200 00	140 00	,,	160 00
Dust	do	140 00	,,	200 00	75 00	,,	125 00	75 00	,,	90 00
Do Flying	do	100 00	,,	145 00	60 00	,,	95 00	40 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th NOVEMBER, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	1215	17	465	732	1	17
	Foot-and-mouth disease	1944	13	1925	19	—	—
	Anthrax	7	—	—	7	—	—
	Hæmorrhagic Septicæmia	6	—	2	4	—	—
	Rabies	1	—	—	—	—	1
Colombo Municipality	Rinderpest	1235	21	*			
	Foot-and mouth disease	154	—				
	Anthrax	—	—				
	Rabies	2	—				—
Cattle Quarantine Station	Rinderpest	10	—	*			
	Foot-and-mouth disease	27	—				
	Anthrax	187†	6				
	Pleuro-Pneumonia (in goats)	115	—				
Central	Rabies (Dogs)	13	—	—	13	—	—
	Foot-and-mouth disease	965‡	34	894	17	54	—
	Anthrax	8	—	—	8	—	—
	Hæmorrhagic Septicæmia	1	—	—	1	—	—
	Piroplasmosis	4	—	4	—	—	—
	Mange (in Buffaloes)	6	—	6	—	—	—
Southern	Rinderpest	192	39	54	136	2	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98§	—	3	95	—	—
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	29	20	9	—	20	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	338	—	126	198	—	14
	Foot-and-mouth disease	1319	17	1304	5	9	1
	Anthrax	12‖	—	—	12	—	—
	Rabies (Dogs)	2	—	—	—	—	2
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	205	48	204	—	1	—
	Anthrax	—	—	—	—	—	—
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	11	2	9	—	2	—
	Anthrax	3	—	—	3	—	—
	Black Quarter	26	—	—	26	—	—
Sabaragamuwa	Rinderpest	35	—	4	25	—	6
	Foot-and-mouth disease	2343	48	2336	5	2	—
	Anthrax	12	—	—	12	—	—
	Hæmorrhagic Septicæmia	17	—	—	17	—	—
	Rabies (Dogs)	2	—	—	1	—	1

* Up to end of October.
† 2 cases amongst cattle, the rest amongst goats.
‡ 39 cases mouth disease in goats.
§ 23 cases amongst goats. ‖ 1 dog

M. D. S. A. WIJAYANAYAKA,
Acting Government Veterinary Surgeon.

Colombo, 4th December, 1924.

METEOROLOGICAL
NOVEMBER, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	79·8	+0·2	81	7·1	W	80	9·61	16	— 1.48
Puttalam	79 2	0	80	4·2	Var:	102	5·68	15	— 4·57
Mannar	80·4	0	80	7·7	Var:	139	5·32	14	— 4·99
Jaffna	79·8	+0·4	78	7·7	Var:	107	10·01	16	— 4·53
Trincomalee	80·3	+0·3	78	6·7	W	139	9·91	14	— 4·11
Batticaloa	80·0	+0·4	78	5·2	W	134	8·21	14	— 4·98
Hambantota	80·0	—0·4	81	5·3	WSW	203	5·84	12	— 0·94
Galle	79·2	0	82	6·4	W	171	11·09	17	— 0·37
Ratnapura	80·4	+0·5	72	6·2	—	—	14·52	14	+ 0·18
Anu'pura	79·3	+0·5	80	6·4	—	—	8·42	14	— 2·24
Kurunegala	79·2	—0·2	80	6·8	—	—	9·40	17	— 2·09
Kandy	75·1	—0·3	82	7·4	—	—	4·88	19	— 5·69
Badulla	72·6	+0·1	83	6·5	—	—	9·33	15	— 1·12
Diyatalawa	67·7	+0·7	78	7·4	—	—	6·32	19	— 3·21
Hakgala	60·6	+1·0	86	7·8	—	—	11·03	18	+ 0·21
N.' Eliya	60·7	+1·5	80	7·8	—	—	6·25	17	— 2·75

The rainfall in November was appreciably below average and in about a third of the island the deficit amounted to more than five inches. Up to the middle of the month there was a fair amount of rain and the deficit is chiefly due to the dryness of the period from the 15th to the 24th. There was appreciable rain, chiefly in the south, on the 24th and 25th and rather more on the next few days but in most cases not enough to bring the totals up to the average.

The stations at which the average value for the month was reached were chiefly in the low country south and west of the main hills.

The highest records of a day's rainfall occurred for the most part on the 7th-8th and include Rayigam 11·11 inches while other stations to record over ten inches in the day were Geekianakanda, Kanana, Hinidum, Sirikandura—all of which will be found to come within the area referred to above, in which the month's average was reached.

In the first half of the month day temperatures tended to be below, and night temperatures above, their respective averages, while in the second half these conditions were reversed. The resultant mean temperature for the month works out in most cases to a trifle above the mean value for previous Novembers. humidity was consistently below average but amount of cloud was, in most cases, above.

The general pressure gradient differed from the ordinary one in November chiefly in the northern part of the island, where it was less northerly than usual. As a result the wind directions at the northern stations were too variable to admit of being summarised by a single mean direction, while the velocities in the south were a trifle above their average.

A. J. BAMFORD,
Supdt. Observatory.